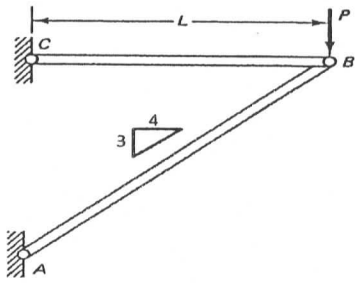
Tanta University
Faculty of Engineering
Production Engineering & Design Dept.
2nd Year Prod. 2013/2014

Stress Analysis
Saturday, 4.1.2014
Time allowed : 3 hours
Final Grade : 100 Marks

Final Exam

Solve all questions and make use of the information given in the last page :

Question 1 : (20 marks)



The pinned beams **AB** and **BC** having the same cross sectional area ***A*** and made from the same material with modulus of elasticity ***E*** support only axial loads. A vertical load ***P*** is applied at point B.

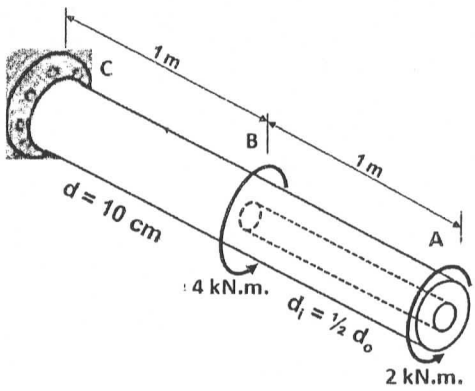
i) Find the reactions at A and C.
ii) Get the horizontal displacement of point B.
iii) If temperature of beam **BC** is increased by ΔT, find the change of stress in beam **AB**.

Question 2 : (25 marks)

a) A rectangular cross-section of height "**h**" and depth "**b**" is subjected to a direct shear force "**W**". Derive an expression for the shear stress distribution on the cross section. (Hint: Assume a cantilever of the same cross-section subjected to end load "**W**")

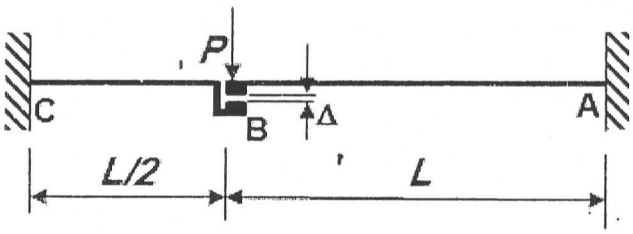
b) The shown shaft is hollow beteen A and B and the rest of the shaft is solid.

i) Draw the axial variation of twisting moment and the angle of twist in degrees.(G = 80 GPa)
ii) Calculate the maximum shear stress and the strain energy absorbed in the shaft.
iii) If the allowable shear stress for the shaft material is 50 MPa, find the largest possible hole diameter for the part AB.



Question 3 : (25 marks)

For the given contactor find the force applied on beam AB necessary to achieve contact at point B.
If after the contact is achieved the force is doubled, determine the reactions at point C.
Beams AB and BC are of length "***L***" and "***L/2***" respectively and both beams have a constant value of "***EI***".



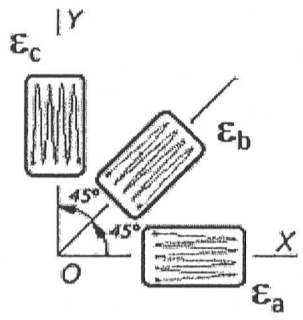
(Hint: The vertical deflection of a cantilever of length L and modulus of elasticity E due to end moment M is $v = \frac{M x^2}{2EI}$)

Question 4 : (25 marks)

At point "**A**" of a machine member made of steel a plane stress condition. and the stress :

$\sigma_x = 150\ MN/m^2$; $\sigma_y = -30\ MN/m^2$; $\tau_{xy} = -70\ MN/m^2$

The readings of the shown strain gauge rosette on another point "**B**" are: $\varepsilon_a = 5\times10^{-4}$ $\varepsilon_b = 2\times10^{-4}$ $\varepsilon_c = -10^{-3}$



i) Draw Mohr's circle for point "**A**" and hence get the principal stresses:
ii) Calculate the shear strain at point "**B**".
iii) Consider plane strain condition, what are the principal strains at point "**B**" ?
iv) Get the three principal stresses at point "**B**" using:

$$\begin{matrix}\sigma_1\\2\\3\end{matrix} = \frac{E}{(1+\nu)}\left[\begin{matrix}\varepsilon_1\\2\\3\end{matrix} + \frac{\nu}{(1-2\nu)}(\varepsilon_1+\varepsilon_2+\varepsilon_3)\right]$$

v) Justifying your answer and according to von Mises yield criterion, which of the two points is critical?

Question 5 : (25 marks)

a) Get the stresses developed in a thin-walled and closed cylinder of mean diameter "***D***" and length "***L***" subjected to internal pressure "***P***". Calculate the change in the internal volume of this cylinder due to the applied pressure.

b) A closed thick-walled pressure vessel made of steel, has an inside diameter of 100 mm, and an outside diameter of 141.421 mm. The pressure inside the vessel reaches 50 MPa. Determine the stress and strain components at the inner diameter. Sketch the stress components across the wall thickness.

Useful information:

For steel: E = 200 GPa ; ν = 0.3

Strain transformation: $\varepsilon_\theta = \varepsilon_x \cos^2(\theta) + \varepsilon_y \sin^2(\theta) + \gamma_{xy} \sin\theta \cos\theta$

Principal strains: $\begin{matrix}\varepsilon_1\\2\end{matrix} = \frac{\varepsilon_x+\varepsilon_y}{2} \pm \sqrt{\left(\frac{\varepsilon_x-\varepsilon_y}{2}\right)^2 + \left(\frac{\gamma_{xy}}{2}\right)^2}$

von-Mises yield criterion: $\sigma_Y = \frac{1}{\sqrt{2}}\sqrt{(\sigma_1-\sigma_2)^2+(\sigma_2-\sigma_3)^2+(\sigma_3-\sigma_1)^2}$

Castigliano's theorem: $v = \frac{\partial}{\partial P_c}\int_0^L \frac{M_z^2}{2EI}dx$; Double integration method: $\frac{d^2v}{dx^2} = \frac{M}{EI}$

Stresses in thick-walled cylinders: $\begin{matrix}\sigma_r\\\theta\end{matrix} = \frac{P_i}{(\lambda^2-1)}\left(1 \mp \frac{r_o^2}{r^2}\right)$ $\sigma_l = \frac{P_i}{(\lambda^2-1)}$

Stress-strain relation: $\varepsilon_\theta = \frac{1}{E}[\sigma_\theta - \nu(\sigma_r+\sigma_l)]$

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تابع الامتحان

Tanta University

Department: Engineering Physics and Mathematics
Total Marks: 100 Marks

Faculty of Engineering

Course Title: Mathematics (3)	Course Code: PME2112	Year: 2nd (Mechanical Production Eng.)
Date: JAN 18th 2014 (First term)	Allowed time: 3 hrs	No. of Pages: (2)

Remarks: (Answer All of The Following Questions)

Question number (1) **(20 Marks)**

The general equation for the unidirectional steady state non-Newtonian flow through a longed horizontal and unit vertical rectangular channel with viscosity dependent domain can be casted in the following differential form

$$\frac{d}{dy}\left(2\nu\frac{du}{dy}\right)+\frac{dp}{dx}=f,$$

Where u is the required velocity, $\frac{dp}{dx}\approx 0$ is the pressure gradient (assume its value here is neglected), $\nu=y^2$ is the viscosity, $f=2(k^2-y^2)u$ is the external force, k is a constant value, y refers to the vertical direction of the channel and x refers to the horizontal direction of the channel. Using the method of Frobenius for power series, predict the distribution of velocity along the vertical direction of the channel and the distribution of the stream function $\psi=\int u\,dy$.

Question number (2) **(20 Marks)**

1. Find the value of $\Gamma\left(\frac{7}{2}\right)$. (4 Marks)
2. Evaluate the integrals $\int_0^2 x^3\sqrt{8-x^3}dx$ and $\int_0^\infty \frac{1}{1+x^4}dx$. (4 Marks)
3. Evaluate for the Bessel function of order k (J_k) the value of $J_{\frac{3}{2}}$. (4 Marks)
4. Prove that $\cosh^{-1}z=\mathrm{Ln}(z+\sqrt{z^2-1})$ and find the period of $\cosh(iz)$. (4 Marks)
5. Solve the equation $sinhz=0.5$. (4 Marks)

Question number (3) **(20 Marks)**

1. Evaluate for the complex number z the principal value of z^z when $z=i$. (4 Marks)
2. Represent graphically the set of values of z for $|z-1||z+1|=1$. (4 Marks)
3. Sketch the domain of the complex function $f(z)=\frac{z+\bar{z}}{z\bar{z}-1}$ and discuss its continuity at the point (1,0). (4 Marks)
4. Let $f(z)=u+iv$ be analytic function and $u=4x-x^2+3xy^2$ find v and $\frac{df(z)}{dz}$. (4 Marks)
5. Verify that $u=e^{-x}(xsiny-ycosy)$ is a harmonic function. (4 Marks)

P.T.O.

Question number (4) **(20 Marks)**

1. Let f(z) be an analytic in a simple connected domain and let C be a simple closed contour lying entirely within the domain, if z_o is any point interior in C then prove that $2\pi i\, f^{(n)}(z_o) = n!\oint_C \frac{f(z)}{(z-z_o)^{n+1}}dz,\ \ n = 0,1,2,3,\ldots$ (4 Marks)
2. Evaluate $\int_C Re\{z^2\}\,dz$ where C is the straight line joining $1-\pi i$ and $2+3\pi i$. (4 Marks)
3. Evaluate $\oint_C \frac{\sin(\pi z^2)+\cosh(\pi z^2)}{(z-1)(z-2)}dz,\ \ C: |z| = 0.5.$ (4 Marks)
4. Evaluate $\oint_C \frac{Ln(z)}{(z-2i)^3(z+4i)^2}dz,\ \ C: |z| = 3.$ (4 Marks)
5. Find the image of the circle $x^2+y^2 = 2x$ under the mapping $w = \frac{1}{z}$. (4 Marks)

Question number (5) **(20 Marks)**

1. Let f(z) be an analytic function within and on a closed contour C except at a finite number of singular points $z_1, z_2, \ldots, z_n$ interior to C. Then prove

$$\oint f(z)dz = 2\pi i \sum_{i=1}^{n} \underset{z=z_i}{Res}\{f(z)\}$$

Where the integral is taken counter clockwise around C. (4 Marks)

2. Find the Laurent series for $f(z) = (z-3)\sin\frac{1}{z+2}$ about z = -2 then name the singularity and give the region of the convergence. (4 Marks)
3. Expand $f(z) = \frac{1}{(z+1)(z+3)}$ in a Laurent series valid for $0 < |z| < 3$ and find its residue. (4 Marks)
4. Using the residue theorem to evaluate $\int_{-\infty}^{\infty} \frac{cosm\theta}{x^2+1}dx.$ (4 Marks)
5. Using the residue theorem to evaluate $\int_{-\infty}^{\infty} \frac{x^2}{(x^2+1)^2(x^2+2x+2)}dx.$ (4 Marks)

With Best Wishes

Course Examination Committee and Course Coordinator

Dr. Mohamed Elborhamy

تابع ج

Tanta University Department: Prod Engineering and Mech Design Dept **Faculty of Engineering**
Total Marks: 85 Marks

Course Title: Theory of Machines	Course Code: MPD2109,2151	Year: 2nd MechYear
Date: 11-01-2014	Allowed time: 3 Hr	No.of Pages: (2)

Attempt All Questions[Illustrate all answers with neat sketches whenever possible]:-

Question (1):- [15 = 5x3 Marks]

(a) Define the following terms:-
Mechanism – kinematic link and Kinematic pair – Machine – Stucture – Degree of freedom – Kinetics - Absolute and Relative Motion .
Machine- Mechanics- Structure.

(b) With the help of a neat sketch explain the working of single slider and double slider crank chain mechanism.

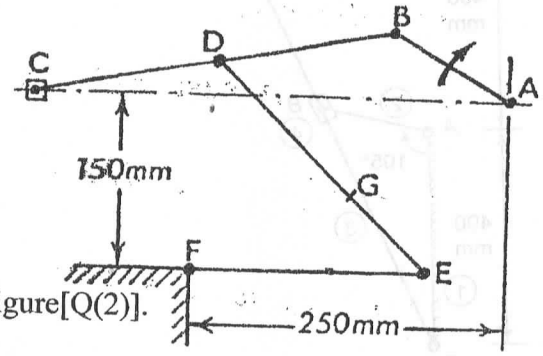
(c) Draw a neat sketch of Quick return mechanism and explain its working to calculate time ratio, mean cutting speed (assume any dimensions).

(d) State and explain the relative velocity and acceleration of a point on link.

(e) Distinguish between machine structure on the base of:-
(i) Motion. (ii) Type of entity transferred. (iii)Mechanism. (iv) Application.

Question (2):- [15 Marks]

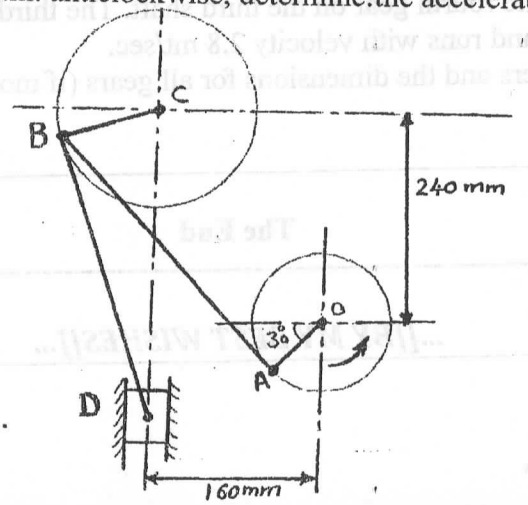
In the mechanism shown in Figure below, the link AB rotates with a uniform angular velocity of 30rad/s Determine the velocity and acceleration of G for the configuration shown.The length of the various links are, AB= 100 mm; BC= 300 mm; BD= 150 mm; DE= 250 mm; EF= 200 mm; DG= 167 mm; and angle CAB= 30°.



Figure[Q(2)].

Question (3):- [15 Marks]

The Figure below shows the mechanism of a moulding press in which OA=80 mm, AB=320mm, BC= 120mm, BD=320mm. The vertical distance of OC is 240mm and horizontal distance of OD is 160 mm. When the crank OA rotates at 120 r.p.m. anticlockwise, determine:the acceleration of D and the angular acceleration of the link BD.



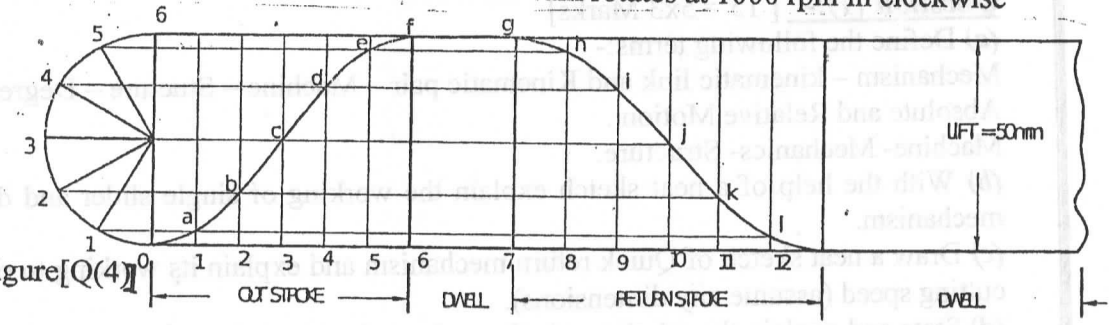
Figure[Q(3)].

P.T.O. → (2)

Question (4):- [15 Marks]

Draw the cam profile for the following conditions:-

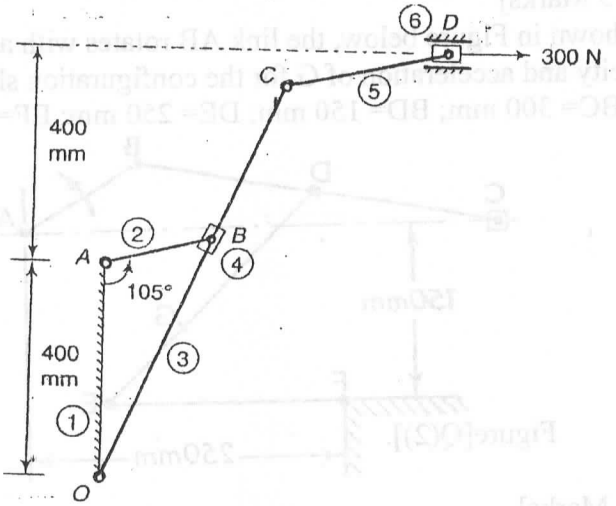
Follower type = Knife edged, with the follower offset by 10 mm to the right of cam center; lift = 50mm; base circle radius = 50 mm; out stroke with SHM, for 60° cam rotation; dwell for 45° cam rotation; return stroke with SHM, for 90° cam rotation; dwell for the remaining period. Determine maximum velocity and acceleration during out stroke and return stroke if the cam rotates at 1000 rpm in clockwise direction.



Figure[Q(4)]

Question (5):- [15 Marks]

For the static equilibrium of the quick return mechanism shown in the following figure, determine the input torque T_2 to be applied on link AB for a force of 300N on the slider D. The dimensions of the various links are OA= 400mm, AB= 200mm, OC=800mm, CD=300mm.



Figure[Q(5)]

Question (6):- [10 Marks]

A shaft running at 1450 rpm from an electric motor carries one gear whee l(T_1= 20 teeth). A second shaft is parallel to the first shaft and carries two fixed gears (the second gear and the third gear), the third gear wheel gears with the fourth gear on the third shaft. The third shaft carries also output pulley which has diameter 250mm and runs with velocity 2.8 mt/sec.

Find the suitable teeth numbers and the dimensions for all gears (if module = 5 mm).

The End

...[[BY MY BEST WISHES]]...

Examiner:***Dr Eng: Alaa-Eldin A. El-Hammady***

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Tanta University | Department: Prod Engineering and Mech Design Dept | Faculty of Engineering

Total Marks: 40 Marks

Course Title: Engineering Economy	Course Code: MPD2113	Year: 2nd Prod Dept
Date: 20-01- 2014	Allowed time: 2 Hr	No.of Pages: (2)

Answer All The Following Questions:-

Question (1):- (9 Marks)

(a) What do you understand by the "production cycle"? and what is the meaning of 3 S's?.

(b) A company is considering the advantages of automating a part of their production line . The company's financial statement is shown below:-

Total Sales.....	LE $40x10^6$
Direct Labor.....	LE $12x10^6$
Indirect Labor	LE $2x10^6$
Direct material.....	LE $8x10^6$
Depreciation.....	LE $1x10^6$
Taxes.....	LE $0.5x10^6$
Insurance.....	LE $0.4x10^6$
Sales cost.....	LE $1.5x10^6$

The above report is based on the production and sales of 100000 units.The production manager believes that with an additional investment of LE $5x10^6$ he can reduce variable cost by 30%.The same production volume would be maintained. Using of five-years, straight line depreciation (that is LE1000000 per year), **construct a break-even chart.** If the company inserts an a 20% return on its investments, **should they automate?..**

Question (2):- (10 Marks)

(a) What are the measures of effectiveness for the design of a total production system would include?..

(b) A company has for many years maintained the selling price of its products of 4 LE/unit. Increasing costs have made the manager wonder whether the historical unit sales price of LE 4 should be changed.Costs have increased as follows:-

* Material cost has risen from LE 0.8 to LE 0.9 per unit.
* Labor cost has risen from LE 1.12 to LE 1.5 per unit.
*Variable factory overheads have risen from LE 0.32 to LE 0.4 per unit.
*Variable selling and administrative expenses have risen 25% approximately LE 0.04 per unit.
*Fixed overheads have increased from LE 120000 to LE 160000 per year.
*Fixed selling and administrative expenses have risen from LE 40000 to LE 60000 per year.

Required:-

(a) If the company was operating at its full capacity (200000 units per year).**How much was the actual total net profit?..**

(b) By how much should the selling price be increased to break-even with the total cost at the past break-even volume? **and how much** is the total annual net profit in this case if the company will still operating at its full capacity..

Question (3):- (7.5 Marks): 5x1.5

(a) Deduce and express the increase in costs due to a deviation from: $\xi = (P-1)/(" \frac{1}{2}"u+1)$.

(b) Prove that at the minimum –cost batch size, $Q_m = \sqrt{(2a_cS)/[I(1+\gamma) + 2B]}$.

(c) Derive that the production range: $Q_{I,II} = Q_m (p+\sqrt{p^2 - 1})$.

(d) Explain with drawing, what are the methods for icreasing the profit?.

(e) Define the three **S's.**

Question (4):- (7.5 Marks): 4+2x1.5

(a) When the minimum-cost batch size is produced, it is known that the variable costs constitute 20 percent of the total production costs. If "Q_m" is increased by 25 percent, **what increase** in production costs can be expected?..

(b) What are the main factors affecting the selection of batch size?..

(c) Prove that the desirable level of production volume: $Q_2 = Q_1[1 +(Z/F)]$..

P.T.O. → (2)

Question (5):- (6 Marks): 4x1.5

(a) Define and explain the break-even analysis with neat sketches.

(b) Explain and state types of costs, and what do the costs to the firm consist of?..

(c) Explain briefly how can you construct the multiproduct profit-volume chart..

(d) Explain briefly the stock control with a buffer stock..

..Good Luck..

&

[[WITH MY BEST WISHES]]

Examiner: Dr Eng: Alaa-Eldin A. El-Hammady..

Tanta University

Department: Mechanical Power Engineering

Exam Total Marks 85

Faculty of Engineering

Course Title: Fluid Mechanics	Course Code : MEP 2150	Year : 2nd Production
Date: January 6th 2014 (First Term)	Allowed Time : 3 hrs	No. of Pages: (3)

Remark: (Answer all the following questions. Assume any missing data)

Question Number (1) (15 Marks)

Mark each statement as true {T} or false {T}. [No need to justify your answer]

1. In a flow that is uniform at a given cross section, the velocity is constant across any section normal to the flow.
2. For a fluid at rest, there will be no shear stresses.
3. A turbo machine is a device that exchanges energy with a fluid using continuously flowing fluid and rotating blades.
4. Non-Newtonian fluids commonly are classified as having time-independent or time-dependent behavior.
5. We define a liquid as "wetting" a surface when the contact angle $\theta<90^{o}$.
6. Factors that affect the contact angle between fluid and solid surface include the cleanliness of the surface and the purity of the liquid.
7. A laminar flow is the flow in which the fluid particles move in smooth layers, or laminas.
8. Flows completely bounded by solid surfaces are called internal or duct flows.
9. Any shear stress applied to a fluid, no matter how small, will result in motion of that fluid.
10. A gas has no definite volume, and when left to itself without confinement, a gas forms an atmosphere which is essentially hydrostatic.
11. A dimension is the measure by which a physical variable is expressed quantitatively.
12. When the fluid velocity is zero, denoted as the hydrostatic condition, the pressure variation is due only to the weight of the fluid.
13. Both internal and external flows may be laminar or turbulent, compressible or incompressible.
14. A fluid is called a continuum when its variation in properties is so smooth that the differential calculus can be used to analyze the substance.
15. There are two main kinds of wind generators, those with a vertical axis, and those with a horizontal axis.

Question Number (2) (30 Marks)

I. A vacuum gage connected to a chamber reads 5.8 psi at a location where the atmospheric pressure is 14.5 psi Determine the absolute pressure in the chamber. (10 Marks)

II. The force, P, that is exterted on a spherical particle moving slowly through a liquid is given by the equation: $P = 3\pi\mu DV$

Where μ is a fluid proerty (viscosity) having dimensions of $FL^{-2}T$, D is the particle diameter and

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d. Local acceleration, and convective acceleration.

e. Kinematic viscosity, and dynamic viscosity.

Question Number (4) (15 Marks)

I. From point 1, a 25-mm diameter pipe runs horizontally under the floor and then a 12.5-mm diameter line runs 1 m up the wall to point 2. To maintain a pressure of 300 kPa at point 2 , when 15°C water is flowing at 0.5 L/, what pressure must be provided at point 1 .Neglect friction. (5 Marks)

Given: for water at 15°C $\gamma = 9798\ N/m^3$.

II. Freshwater and seawater flowing in parallel horizontal pipelines are connected to each other by a double U-tube manometer, as shown in Figure 2. Determine the pressure difference between the two pipelines. Take the density of seawater at that location to be $\rho = 1035\ kg/m^3$. Can the air column be ignored in the analysis? (8 Marks)

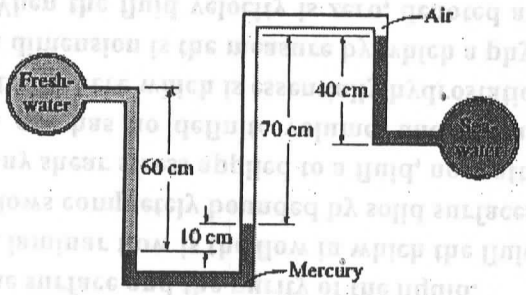

Figure (2)

Which of the following velocity fields satisfies conservation of mass for incompressible plane flow? (2 Marks)

a. $u = -x,\ v = y$

b. $u = 3y,\ v = 3x$

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With my best wishes:

Dr. Eng. Hagar Alm El Din Bastawissi and committee

V is the particle velocity. What are the dimensions of the constant, 3π? Would you classify this equation as a general homogenous equation? (5 Marks)

III. Provide a neat drawing showing the capillary rise or fall of a column of water or mercury, respectively. Find a general expression for the capillary rise or fall as function of tube diameter D. Find the minimum diameter of each column required so that the height magnitude will be less than 1 mm. (10 Marks)

Given:

For water, σ =72.8 mN/m and $\theta = 0^{\circ}$, and for mercury, σ =484 mN/m and $\theta = 140^{\circ}$.

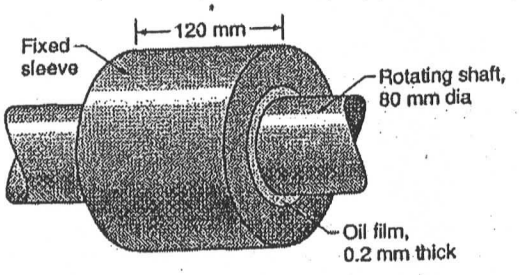
IV. Prove that, when the static fluid is subjected to acceleration then a pressure gradient in the horizontal direction is possible. (5 Marks)

Question Number (3) (25 Marks)

I. What is Euler's equation of motion? How will you obtain Bernoulli's equation from it? Clearly state the assumptions made to obtain both equations. (5 Marks)

II. A journal bearing consists of an 80-mm shaft in an 80.4-mm sleeve 120 mm long, the clearance space (assumed to be uniform) being filled with SAE 30 Western lubricating oil at 40°C (Figure 1). Calculate the rate at which heat is generated at the bearing when the shaft turns at 150 rpm. Express the answer in *kN.m/s, J/s , Btu/hr , ft.lb/sec and hp*. (10 Marks)

Given $\mu = 0.11$ N.s/m^2



(Figure 1)

III. Explain with clear drawings, when needed, the difference between each of the following expressions in each group: (10 Marks)

a. Fans, and Ejectors.

b. Pumps, and Compressors.

c. Gas turbines, and wind turbines.

Tanta University
Faculty of Engineering
Production Eng. &Mech.Des.Dept.

(*Casting of metals*)
(*MPD2108*)

2st year: production.
Time allowed: 3 hrs.
Date: 22-1-2014

Answer the following questions:- with illustrated graphic (90 Marks)

1- Explain the main advantages of the casting processes over other methods of fabrication.

2- writ short notes about on:-
   a) Shell Molding,
   b) Investment Casting,
   c) Pressure Die Casting,
   d) Continuous Casting and
   e) Sintering.

3- Explain briefly, the general properties of molding sand.

4- Distinguish between the following three types of melting furnace?
   a- Copula Furnace
   b- Electric Furnace
   c- Siemens Martin Furnace

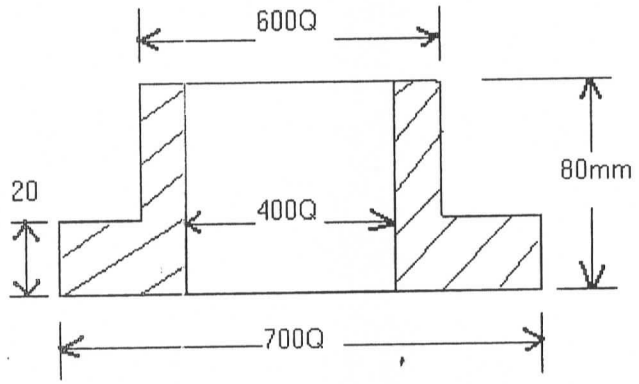
5- What are the basic requirements of core sand? In what respect does it differ from the molding sand?

6- Describe the various types of precision casting?
7-Draw a neat sketch of the powder metallurgy processes?
8- Mention the advantage and disadvantages of powder metallurgy processes.

9- You are asked to produce the shown casting from an Al alloy.
   Required:
   a- The shape and dimensions of the pattern.
   b- Draw the risering equation of Al alloy and then find out the optimum size and dimension of the riser or (risers) required to feed the casting showing its location, and the risering equation of Al: Fr = 1.38/[1-(0.0417/VR)].

   Where, Fr = freezing ratio = (Ac/Vc)/ (Ar/Vr)
   VR= volume ratio = (Vr/Vc), use standard feeder.

Cheek your results analytically.



Some useful data:

Coefficient of linear thermal expansion of cast iron = 11×10^{-6} / °C.

Coefficient of linear thermal expansion of aluminum = 24.10^{-6} / °C.

Freezing temperature of cast iron = 1150 °C.

Melting point of aluminum = 660 °C.

Machining allowance = 3 mm.

9- Calculate the carbon index and the chemical composition of the cast iron produced from the following charge:

Raw Material	% C	% Si	% Mn	% P	% S
60% Hematite	4	2.5	0.8	0:1	0.04
20% Iron scrap	3.5	1.8	0.5	0.2	0.02
20% Pig iron	3-4	2-3	0.3-0.9	0.3	0.02
0% FeSi	-	75			

The average losses of C, Si and Mn are 5, 10, and 15% respectively.

The iron will be inoculated with 0.2% FeSi just before pouring.

Prof.Dr.AbdelFattah M.Khourshid