Physics and Engineering Mathematics Department

Tanta University	Year: 2nd Year Mechanical Power Engineering Department	Faculty of Engineering
Date: Jan.12th, 2022 (1st term)	Course Title: Engineering Mathematics (3)	Total Marks: 85
Allowed time: 3 hours	Course Code: PME2113 FINAL EXAM	No. of pages: 2

Please answer the following questions:

Question (1) (45Marks)

(a) If $J_0(2.2) = 0.1104$ and $J_1(2.2) = 0.556$, obtain $J_{-2}(2.2)$. [5Marks]

(b) Show that $\int_0^1 x^m \left(\ln x\right)^n dx = \frac{(-1)^n n!}{(m+1)^{n+1}}$, where n is a positive integer. [10Marks]

(c) Put in the form of $u + iv$ the following: $(4+4i)^5\left(-2+2\sqrt{3}i\right)$. [5Marks]

(d) let $z = x + iy$ and $f(z) = \frac{(z-i)(z-2)}{(z^2+1)\cos\left(\frac{z+\bar{z}}{2}\right)}$. Show graphically where in the following domains, this function fails to be defined:

(d-1) $|z| < 1$ (d-2) $\left|z - (1+i)\frac{\pi}{2}\right| < \frac{\pi}{2}$ [10Marks]

(e) A solid sphere of radius r_o is initially at a uniform temperature T_i. At time $t > 0$, it is allowed to exchange heat with the surroundings by convection as in Fig. 1. The heat transfer coefficient is h, α is the thermal diffusivity, and the ambient temperature is T_∞. If h and T are uniform, the temperature distribution in the sphere will depend on the radial distance only. The equation is given by (where $\theta(r,t) = T(r,t) - T_\infty$)

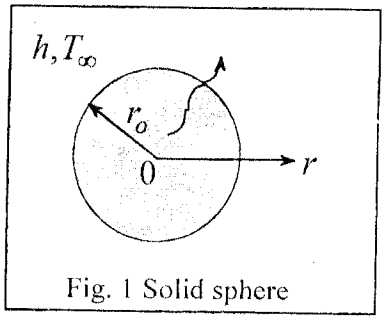


Fig. 1 Solid sphere

$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial\theta}{\partial r}\right) = \frac{1}{\alpha}\frac{\partial\theta}{\partial t} \qquad (1)$$

The separation of variables method is applied to solve the partial differential equation (1) as

$$\theta(r,t) = R(r)\,\tau(t)$$

This yields two ordinary differential equations as ($s = \lambda r$), with λ is a separation parameter,

$$s^2\frac{d^2R}{ds^2} + 2s\frac{dR}{ds} + s^2R = 0 \qquad (2) \qquad \frac{d\tau}{dt} + \lambda^2\,\alpha\,\tau = 0 \qquad (3)$$

The solution of equation (3) is given as $\tau(t) = Cexp(-\alpha\lambda^2 t)$. Use the method of Forbenius to get a solution for equation (2) in terms of r. (Hint: $R = s^{-\frac{1}{2}}M$) [15Marks]

Please, consider page 2/2

Question (2) (40Marks)

(a) Let $f(z) = u + iv$ to be an analytic function with $u = 3x^2y + 2x^2 - y^3 - 2y^2$. Find the conjugate harmonic v and $f'(z)$. [5Marks]

(b) Solve the following equation $\sin z = 10$. [5Marks]

(c) If $\sin^{-1} z = -i \ln\left(iz + \sqrt{1 - z^2}\right)$ and $\frac{d}{dz}\left(\sin^{-1} z\right) = \frac{1}{\sqrt{1-z^2}}$. Find $\sin^{-1} z$ and $\frac{d}{dz}(\sin^{-1} z)$ at $z = \sqrt{5}$. [5Marks]

(d) Let C is as shown in Fig.2. Evaluate $\oint_C \frac{1}{z^2-1} dz$. (Hint: the indicated direction is the counterclockwise direction). [10Marks]

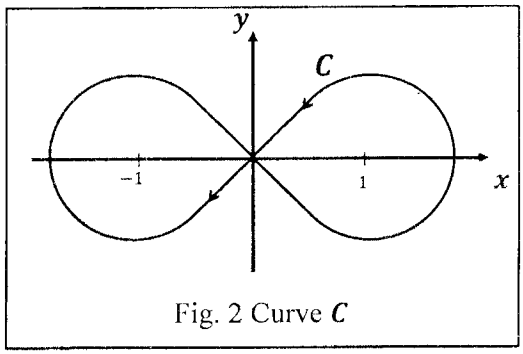


Fig. 2 Curve C

(e) Show that $|z_1 + z_2|^2 + |z_1 - z_2|^2 = 2|z_1|^2 + 2|z_2|^2$. [5Marks]

(f) Evaluate the following integrals

(f-1) $\int_c \cos z dz$ for C any contour from $z = 0$ to $z = 2 + i$. [5Marks]

(f-2) $\oint_C \frac{z-1}{z(z-2)(z+4)} dz$ inside $C: |z| = \frac{5}{2}$. (Hint: the indicated direction is the counterclockwise direction). [5Marks]

Best of Luck

Dr. Ali Mehrez

Tanta University

Mechanical Power Engineering Dept.
Total Marks: 75 marks

Faculty of Engineering

Course Title: Fluid Mechanics
ميكانيكا الموائع

Course Code: MPE 2150
Allowed Time: 3 hrs.

Date: 16th Jan, 2022 (Final Exam)

Final Written Exam
No. of Pages: 2 pages

ANSWER ALL THE FOLLOWING QUESTIONS

Question (1)

(30 Marks)

A) During World War II, Sir Geoffrey Taylor, a British fluid dynamitist, used dimensional analysis to estimate the energy released by an atomic bomb explosion. He assumed that the energy released, E, was a function of blast wave radius R, air density ρ, and time t. Arrange these variables into a single dimensionless group, which we may term the blast wave number. **(5 Marks)**

B) In Figure (1): If the specific weight of used fluids is: Benzene =8640 N/m & Mercury =133100 N/m & Kerosene =7885 N/m & Water =9790 N/m & Air =12 N/m. Determine the pressure difference (in Pa) between points A and B. **(7 Marks)**

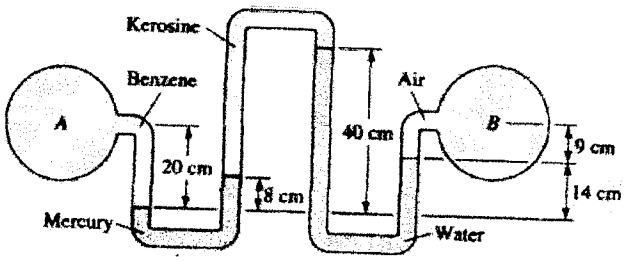


Figure (1)

C) Draw the pressure distribution for an open tank contains a liquid with specific weight (γ), total head (y), and subjected to:

i. Vertical upward acceleration (a_z).

ii. Vertical downward acceleration (a_z).

(8 Marks)

D) A rectangular tank moves horizontally with a linear acceleration of 2 m/s^2 in the direction of its length. The tank is 8 m long, 2 m deep and 2 m wide and it contains water up to a height of 1 m, as shown in figure (2). Find out the following: (i) the slope of the free surface (ii) maximum and minimum pressure intensities at the bottom (iii) total force acting at the front and back end of the tank (iv) volume of water that gets spilled, if the tank is filled with water up to 2 m. **(10 Marks)**

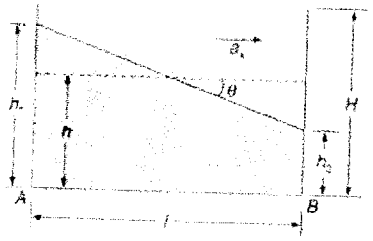


Figure (2)

Question (2)

(30 Marks)

A) What is Cavitation? Mention with drawing where does it probably occur? **(5 Marks)**

B) Water is flowing through a pipe having diameters 600 mm and 400 mm at the bottom and upper end, respectively. The intensity of pressure at the bottom end is 350 KN/m^2, and the pressure at the upper end is 100 KN/m^2. Determine the difference in datum head if the rate of flow through the pipe is 60 litter. **(6 Marks)**

P.T.O >>>>

C) A closed cylindrical tank (Fig. 5) with the air space subjected to a pressure of 102.0424 kPa, 1.9 m height and 0.9 m in diameter, contains 1.45 m of oil (S.G. = 0.9). If the cylinder rotates about its geometric axis,

i. When the angular velocity is 10 rad/sec, what are the pressures in bar at points C, D and E?

ii. At what speed must the tank be rotated in order that the center of the bottom has zero depth? **(10 Marks)**

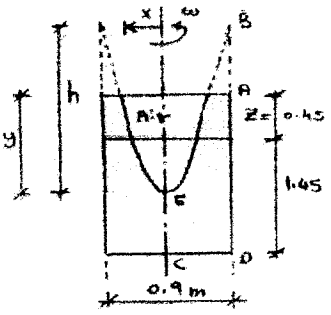


Figure (5)

D) A cylinder 7.5 cm radius and 60 cm in length rotates coaxially inside a fixed cylinder of the same length and 9 cm inner radius as shown in Figure (2). Glycerin $\mu = 8$ Poise fills the space between two cylinders. A Torque 0.4 N.m is applied to the inner cylinder. After a constant velocity is attended, calculate the following: (a) velocity gradient at the cylinder walls, (b) the velocity rustling, and (c) the power dissipated by the fluid resistance. **(9 Marks)**

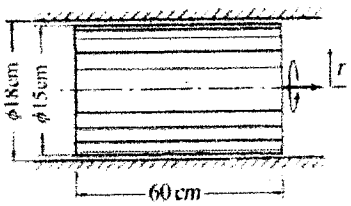


Figure (6)

Question (3) **(15 Marks)**

A) Explain with drawing the effect of increasing the horizontal linear acceleration (a_x) subjected to open tank on: **(6 Marks)**

i. Water surface slope (θ).

ii. Water volume (V).

iii. Rotation point location.

B) A cylindrical vessel 6 cm in diameter and 6 cm high contains water to a depth of 4 cm. How much water will it contain, if rotated at a uniform speed of (i) 120 rpm (ii) 390 rpm? **(9 Marks)**

End of Questions **With my Best Wishes...** *Dr. Ayman Rafaat Eltohami*

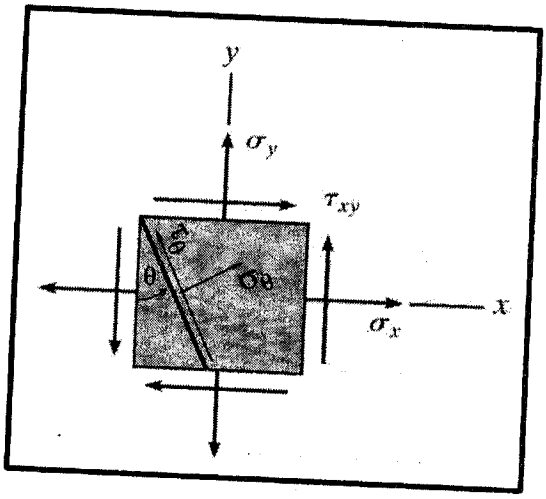
Tanta University
Faculty of Engineering
Production Engineering & Design Dept.
2nd Year Production Eng. & Design 2021/2022
Stress Analysis

MDP2107
Sunday, 23.01.2022
Time allowed : 3 hours
Final Grade : 100 Marks
Number of Pages : 2

Final Exam

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

Question 1 : (20 marks)

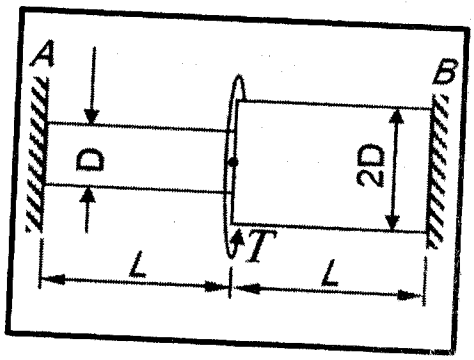


For the shown stress element:

a) Derive the values of the internal stresses σ_θ and τ_θ in terms of σ_x , σ_y , τ_{xy} and angle θ.
b) If σ_x = 15 MPa and τ_{xy} = -30 MPa, get the stress σ_y **using Mohr's circle** knowing that the minimum principal stress is –30 MN/m^2.
c) Also get graphically the value and orientation of the maximum principal stress and the maximum shear stress with its corresponding normal stress.

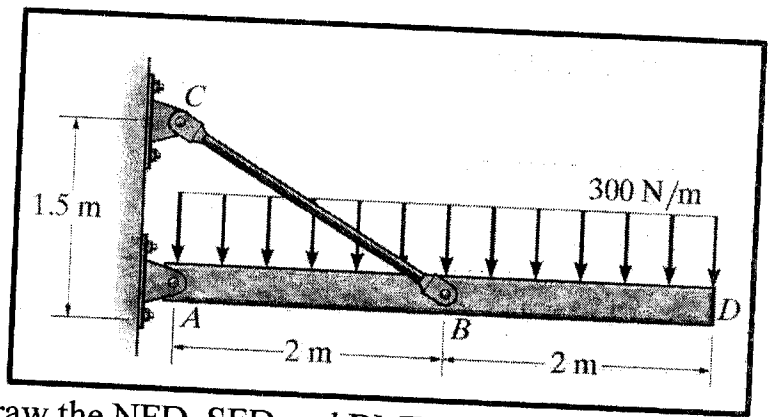
Question 2 : (20 marks)

The shown solid stepped solid shaft is loaded with the twist moment **T** at the given position. In terms of ***D***, ***L***, ***T***, ***G*** and α (thermal expansion coefficient) get:



i. the reactions at the walls.
ii. Draw the twisting moment and twist angle along the shaft.
iii. Calculate the maximum shear stress in the shaft and plot the stress variation across the section having maximum stress.
iv. Determine the strain energy absorbed by the shaft.
v. If the temperature of the shaft is raised by Δ**T** and neglecting the changes in the transverse direction, get the normal stress in the smaller part of the shaft.

Question 3 : (20 marks)



The rigid bar "**AD**" is supported by the pin-connected rod "**BC**". The rod has a cross-sectional area of 14 mm^2 and is made of aluminum (E_{Al} = 70 GPa). Determine:

i. The reactions at the pinned supports "**A**" and "**C**".
ii. The stress in the rod "**BC**".
iii. The stretch in the rod "**BC**".
iv. Use the principle of superposition to draw the NFD, SFD and BMD of the bar "**AD**". (Hint: rod "**BC**" supports only axial loads)

Question 4 : (25 marks)

A horizontal cantilever with 1 m length made of steel is subjected to concentrated load of 1 kN at its free end acting downwards and a twisting moment also at the free end of 1 kN.m. The cantilever has a solid circular cross section. You are requested to:

i. draw the TMD, SFD and the BMD of the cantilever.
ii. determine the position of the most loaded cross section.
iii. plot the stress distributions on the most loaded cross section and hence identify the critical point.
iv. calculate the minimum diameter of the rod to carry the given loads according to von-Mises yield criterion. Use a factor of safety of 3 and 500 MPa yield stress for the used steel alloy and neglect the effect of the transverse shear.
v. get the vertical deflection of the mid-span of the cantilever using a diameter of 100 mm.

Question 5 : (15 marks)

A gas is contained in a thin walled spherical tank under a pressure of 100 bar. The sphere has a diameter of 600 mm and made of steel sheets with thickness of 10 mm and has a yield strength of 500 MPa.

a) Using von-Mises criterion, what is the factor of safety used in the design of this sphere?
b) What will be the reading of a strain gage placed on the outer surface of the tank?
c) Derive an expression to calculate the change of the mean diameter and hence get the percentage change in the internal volume of the tank?

Useful information:

For steel : E = 200 GPa , G = 80 GPa , $\nu = 0.27$

Deformation due to mechanical and thermal normal forces: $\delta_{mech} = \frac{PL}{EA}$; $\delta_{th} = \alpha\, L\, \Delta T$

Direct shear on circular section: $\tau = \frac{4Q}{3A}\left[1 - \left(\frac{y}{R}\right)^2\right]$

Principal stresses : $\sigma_{1\atop 2} = \frac{(\sigma_x+\sigma_y)}{2} \pm \sqrt{\left(\frac{\sigma_x-\sigma_y}{2}\right)^2 + \tau_{xy}^2}$

Double integration method : $\frac{d^2v}{dx^2} = \frac{M}{EI}$

von-Mises criterion : $\frac{\sigma_y}{F.S.} \geq \frac{1}{\sqrt{2}}\sqrt{(\sigma_1-\sigma_2)^2 + (\sigma_2-\sigma_3)^2 + (\sigma_3-\sigma_1)^2}$

Stresses in thin sphere : $\sigma_\theta = \frac{pD}{4t}$

Stress-strain relation : $\epsilon_x = \frac{1}{E}[\sigma_x - \nu(\sigma_y + \sigma_z)]$

مع تمنياتى بالتوفيق و النجاح

د/ نادر نبيل

Tanta University

Total Marks: *40 Marks*

Faculty of Engineering

Course Title: *Engineering Economy* | Course Code: *MPD21H3* | Year: *2nd* Mech. Prod. Dept
Date: 26-*01-2022* | Allowed time: *2Hrs* | No. of Pages: *(2)*

Answer All The Following Questions By Illustrating Your Answers With Neat Sketches (Solve As You Can)
(6 Questions…..Every Question Carries The Same Mark)

Question (1):-

(a)Prove that the production range: $Q_{I,II} = Q_m [p \pm \sqrt{p^2 - 1}]$.
(b)In the minimum-cost batch size, prove that: $Q_m = \sqrt{2a_c S / [I(1+\gamma) + 2B]}$.
(c)Prove that the allowable increase in costs per piece: $\zeta = (p-1)/(0.5u+1)$.
(d)Define: Management - Maintenance - Production Range - BET - Depreciation - Replacement

Question (2):-

(a)It is required to establish the production range for the following data:-
Set up costs……..= L.E. 1000
Carrying charges factor……= L.E. 0.25×10^{-3}*/unit/day*
Constant cost per piece……..= L.E. 2
Allowable increase in cost per piece...= 2.5 %
(b)Define and explain the break-even analysis with neat sketches and what are methods to increase profit?.

Question (3):-

(a)Explain and state types of costs? and what do the costs to the firm consist of?
(b)Operating expenses and revenue for a manufacturing plant approximately by the following relationships:-

Revenue……..= $100\,Q - 0.001Q^2$ *L.E.*
Total Costs……..= $0.005\,Q^2 + 4Q + 200000$ *L.E.*

Required:-
(a)What is the output for maximum profit?
(b)What is the quantity at maximum profit?
(c)What is the output at the BEP?
(d)What is the marginal revenue?
(e)What is the marginal costs?
(f)What is the marginal profit?

Question (4):-

(a)When the minimum-cost batch size is produced, it is known that the variable costs constitute 25‰ of the total production costs. If "Q_m*" is increase by 20‰, what increase in production costs can expected?*
(b)Given a nonlinear price function of:-

$b = 21000\,Q^{-0.5}$ *L.E. per unit*
$a = 1000$ *L.E. per unit*
$F = 1000{,}000$ *L.E. per period*

Determine:-
(a)The break-even point.
(b)The production level for maximum profit.
(c)What are the marginal costs?.

P.T.O. → (2)

Question (5):-

(a) What is depreciation? and what are all the causes of depreciation? and state in few words the various types of depreciation?.

(b) Trucks purchased by a delivery company cost $4000 each. Post records indicate the trucks should have an economic life of 5 years. They can be sold for an average of $800 each after 5 years of use. The company currently receives 7% interest on invested funds.

Determine:-

1- *The depreciation charge during year 1.*
2- *The depreciation charge during year 2.*
3- *The depreciation reserve accumulated by the end of year 2.*
4- *The book value at the end of year 3.*

Question (6):-

(a) What is replacement? and what the reasons for replacement? and what are the two types of replacement? and list out the different types of maintenance?.

(b) A city delivery service with a fleet of panel trucks makes store-to-home deliveries for several merchants. Past records, modified to account for recent price trends, indicate a cost pattern over a 6-year period that is expected to apply to depreciation and maintenance for future truck acquisitions.

Table: The purchase price per truck is $ 3000.

	1	2	3	4	5	6
Operating cost	*$800*	*$1000*	*$1300*	*$1600*	*$2000*	*$2500*
Resale price	*$1600*	*$1000*	*$600*	*$500*	*$400*	*$300*

Assuming a zero interest rate and that all the trucks are going to be replaced at one time. How many years should they be kept in service before replacement?.

End of Examination Paper

...[[With My Best Wishes And Good Luck]]...

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

Course Title: Theory of machines
Course Code: MPD211

Date: 30-1- 2022
Allowed time: 3 hrs.
No. of pages: 2

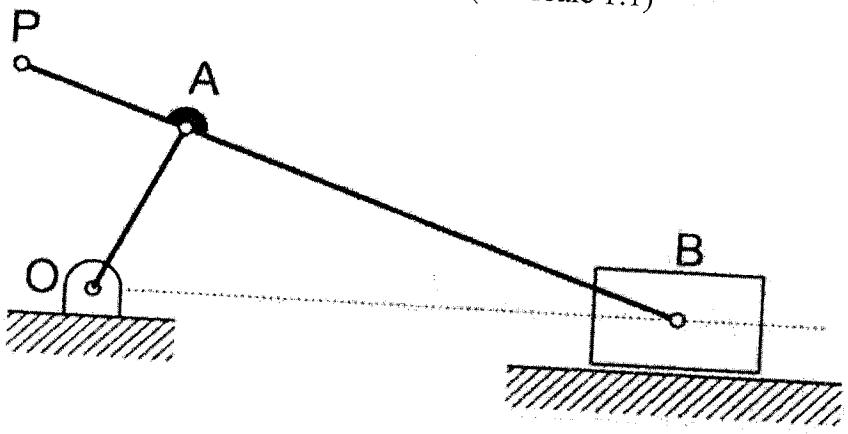
Final Exam

Assume any missing data

Question One

(15%)

Trace the path of point (P) in the following mechanisms (use scale 1:1)

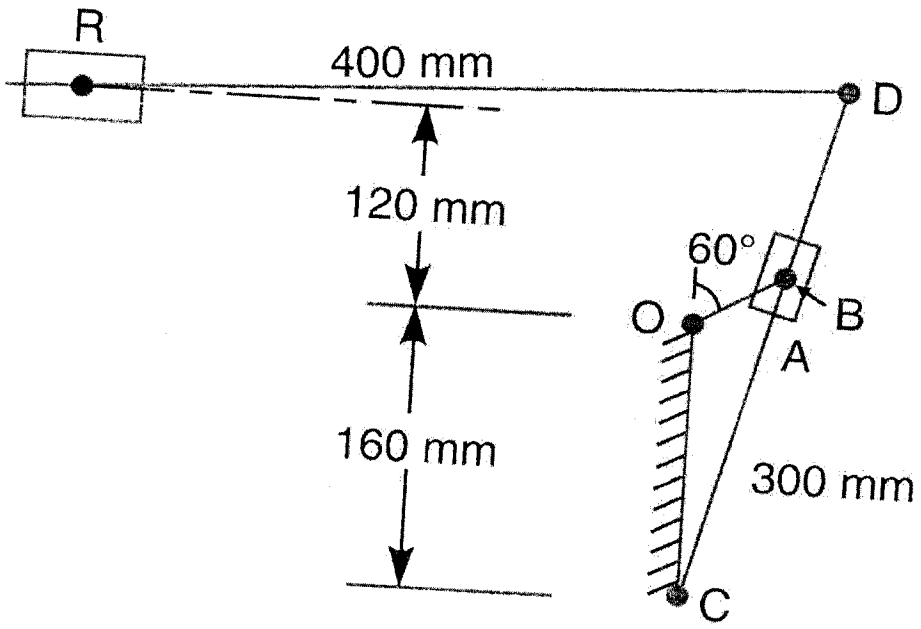


Question Two

(25% Marks)

In a quick return mechanism, OA (60 mm long) is the crank and rotates at 200 r.p.m. in a clockwise direction.

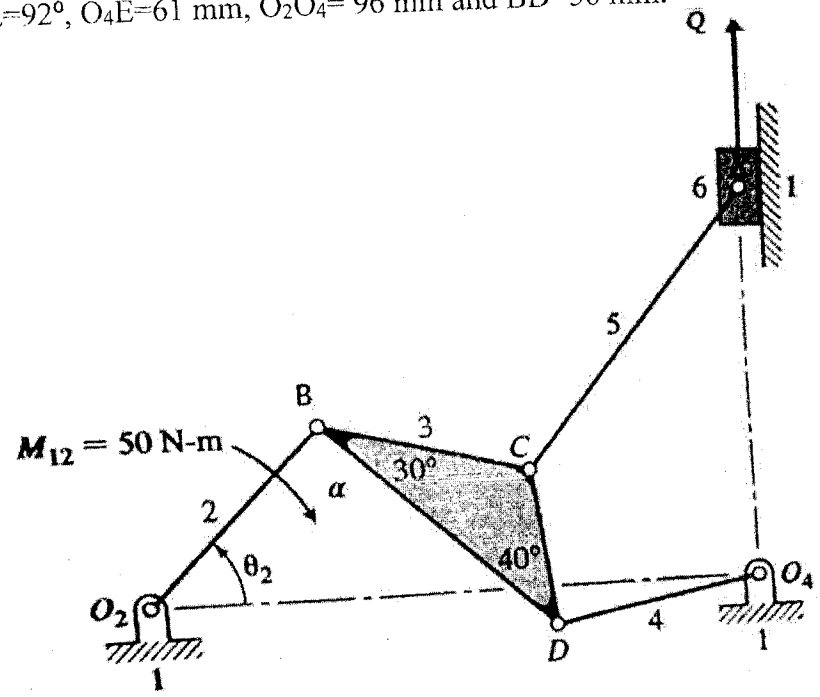
Determine the angular acceleration of CD and acceleration of slider R.



Question Three

(20 %)

Assuming the mechanism shown in the figure is in static equilibrium, determine force Q acting on slider 6. O_2B=40 mm, θ_2=42.5°, α=92°, O_4E=61 mm, O_2O_4= 96 mm and BD=50 mm.



(20%)

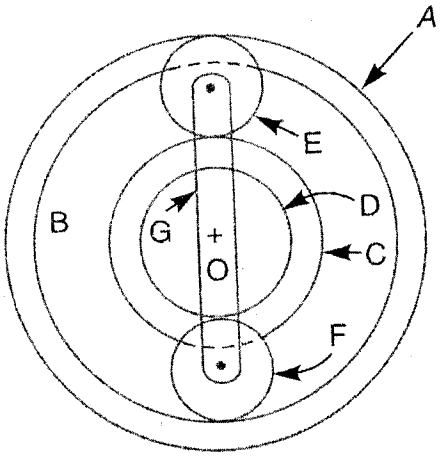
Question Four

Draw the cam profile with oscillating follower (roller) for following conditions:
Base circle radius = 30 mm; roller radius = 10 mm; follower to rise through 30° during 90° of cam rotation with cycloidal motion; dwell for 30°; return stroke with simple harmonic motion during 120° of cam rotation; dwell for the remaining period. The location of pivot point is 60 mm to the left and 40 mm above the axis of rotation of the cam.

(20%)

Question Five

In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the number of teeth are : T_C=28; T_D=26; T_E=T_F=18. If the arm G makes 100 r.p.m. clockwise and wheel A makes 10 r.p.m. counter clockwise ; find the speed of wheel B.



Tanta University

Department: Production Engineering & Mechanical Design
Total marks: 90 Marks

Faculty of Engineering

Course Title: Metal Casting Process
Course Code: MPD 2108
Year: 2nd Year Production

Date: 2-2-2022
Allowed time: 3 hrs.
No. of pages: 2

Final Exam

Answer all the following questions with the help of sketch

Q1.

(20 Marks)

a) Classify the casting processes?

b) Explain the different refining techniques?

c) What is segregation; its types and how to reduce its effect?

d) Describe the shrinkage stages occur through metal solidification and identify the stage at which the riser works.

e) What are the rules of the core design in sand casting process?

f) Define camber allowance.

Q2.

(23 Marks)

a) Clarify the different types of patterns used in casting process?

b) There are many tests used to evaluate the quality of the sand used in the sand-casting process. List these tests and explain in detail two.

c) Why turbulent flow of the molten metal into the mold should be avoided?

d) What are the required properties of the core sand binder?

e) Define and explain the function of core drier.

f) Explain the different rules of sprue and runner design.

Q3.

(23 Marks)

a) Mention the important factors should be taken into account for gates design.

b) Differentiate between the different types of gating system.

c) What is the main function of runner extension?

d) Design the gating system for a casting of size 500×250×50 mm made up of cast iron. The density of solid cast iron = 7.86 gm/cc. The density of liquid cast iron = 6.9 gm/cc. fluidity length =22 inches. Height of cope 100 mm.

e) What is the different between vacuum permanent-mold casting and vacuum molding?

f) Which die casting machines usually have a higher production rate, cold-chamber or hot-chamber, and why?

(24 Marks)

Q4.

a) Explain the Expanded polystyrene process casting process and name its applications.

b) Briefly describe three of the general defects encountered in casting processes.

c) What are the castings defects related to the use of sand molds?

d) Distinguish between the furnaces used in the casting process based on the molten metal.

e) What are the rules for furnace selection in foundries?

f) List the different methods used to inspect the castings. Name these methods?

g) To make brass bushings, with the following dimensions: length = 20 cm, outside diameter = 18 cm, and inside diameter = 13 cm, a horizontal true centrifugal casting process is used. If The brass density 9.62 g/cm^{3}A

Determine

(1) The required rotational speed in order to obtain a G-factor of 80.

(2) When operating at this speed, what is the centrifugal force per square meter (Pa) imposed by the molten metal on the inside wall of the mold?

With my best wishes

Dr. Eng. Saad. M. Ebied

Dr. Eng. Ibrahin. S. Eldeep