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Tanta University | Department: Production Engineering & Mechanical Design | Faculty of Engineering

Total marks: 75 Marks

Course Title: Furnaces and heat treatments
Course Code: MPD 2213
Year: 2rd Year Production

Final Exam

Date: 1-6-2019
Allowed time: 3 hrs.
No. of pages: 4

Q1. **(20 Marks)**

a) Differentiate between oven and furnace?

b) List the different furnaces types based on the heat transfer medium?

c) List the common applications of the bell type furnace?

d) What are the advantages and disadvantages of vacuum furnaces?

e) Explain briefly the working principle of the fluidized beds furnaces and list their applications?

f) List the advantages and disadvantages of molten salt baths?

Q2. **(10 Mark)**

a) What are the reasons for annealing heat treatment process?

b) Describe the full annealing process of the steel?

c) List the different surface hardening processes?

d) Explain briefly the Carburizing process and list its different techniques?

e) What is the difference between Martempering of Steel and Austempering of Steel?

Q3. **(25 Mark)**

a) Explain schematically the microstructural changes that accompany the eutectoid reaction?

b) Name the different strengthening mechanisms?

c) Define the isothermal transformation?

d) Describe the microstructure of the BAINITE and how can we obtain a microstructure of 100% BAINITE in an iron–carbon alloy of eutectoid composition? Showing your answer on the T-T-T curve.

e) What is the effect of the alloying elements other than carbon (e.g., Cr, Ni, Mo, and W) on the Isothermal transformation diagram of the steel?

f) Make a copy of the isothermal transformation diagram for an iron–carbon alloy of eutectoid composition (**Figure 1**), specify the nature of the final microstructure (in terms of microconstituents present and approximate percentages of each) of a small specimen that has been subjected to the following time– temperature treatments. In each case assume that the specimen begins at 760°C (1400°F) and that it has been held at this temperature long enough to have achieved a complete and homogeneous austenitic structure.

1- Cool rapidly to 700°C (1290°F), hold for 10^4 s, then quench to room temperature.

2- Reheat the specimen in part (a) to 700°C (1290°F) for 20 h.

3- Rapidly cool to 600°C (1110°F), hold for 4 s, rapidly cool to 450°C (840°F), hold for 10 s then quench to room temperature.

4- Cool rapidly to 400°C (750°F), hold for 2 s, then quench to room temperature.

5- Cool rapidly to 400°C (750°F), hold for 200 s, then quench to room temperature.

6- Rapidly cool to 575°C (1065°F), hold for 20 s, rapidly cool to 350°C (660°F), hold for 100 s, then quench to room temperature.

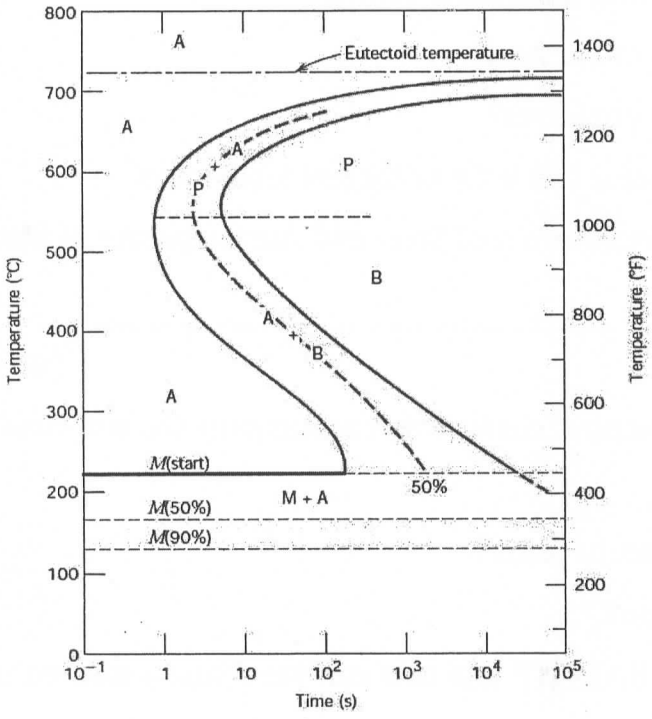

FIGURE 1 Isothermal transformation diagram for an iron–carbon alloy of eutectoid composition.

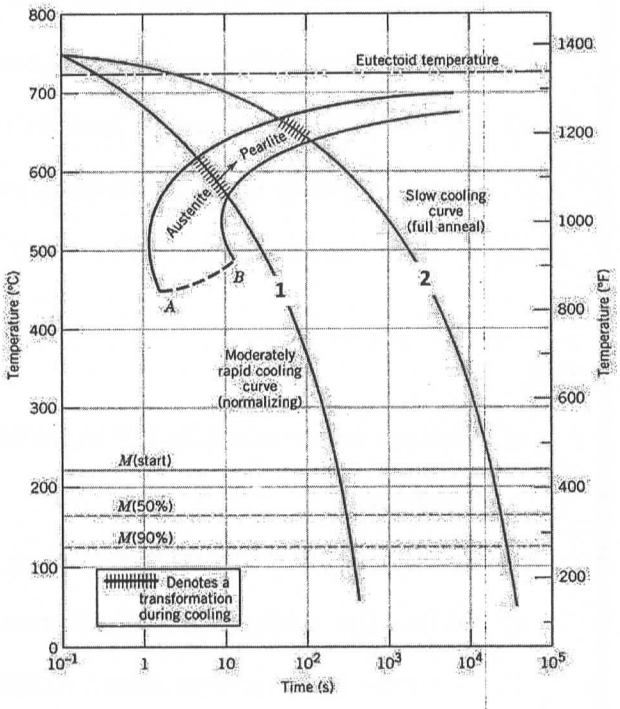

FIGURE 2 A continues cooling transformation diagram for eutectoid iron–carbon alloy.

Q4. **(20 Marks)**

a) Briefly describe the microstructural difference between spheroidite and tempered martensite.

b) Using the CCT diagram (**Figure 2**) describe the final microstructure for cooling rate 1 and 2.

c) Rank the following iron–carbon alloys and associated microstructures from the highest to the lowest tensile strength:

1- 0.25 wt%C with spheroidite

2- 0.25 wt%C with coarse pearlite

3- 0.60 wt%C with fine pearlite

4- 0.60 wt%C with coarse pearlite

Justify this ranking

d) Make a copy of the isothermal transformation diagram for a 0.45 wt% C iron-carbon alloy (**Figure 3**), and then sketch and label on this diagram the time-temperature paths to produce the following microstructures:

1- 42% proeutectoid ferrite and 58% coarse pearlite

2- 50% fine pearlite and 50% bainite

3- 100% martensite

4- 50% martensite and 50% austenite

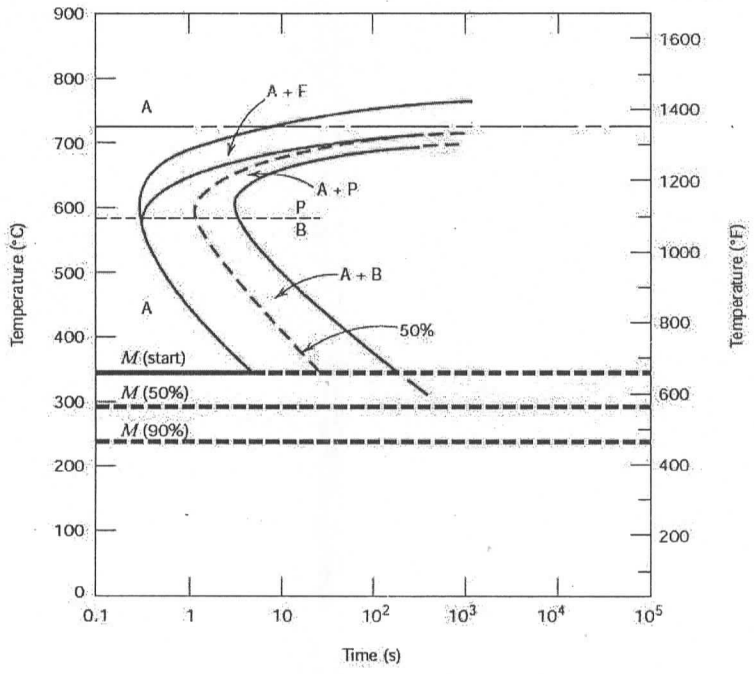

FIGURE 3 Isothermal transformation diagram for a 0.45 wt% C iron–carbon alloy

e) Explain briefly the Jominy End-Quench Test?

f) On the basis of microstructure, briefly explain why gray iron is brittle and weak in tension.

g) Compare between white and nodular cast irons with respect to composition and heat treatment, microstructure, and mechanical characteristics.

With my best wishes

Dr. Eng. Saad .M. Ebied

Tanta University

Production Engineering & Mechanical Design Department

Faculty of Engineering

Course Title	Metrology Measurement Equipment	Final term Exam	Course Code	MPD2212
Date	3/6/2019	No. of Pages 3	Allowed time	3 hrs

Total marks: 60

Question Number (1) (15 Points)

a. What are the different types of callipers in the industry? Please identify your answer with help of sketch?

b. Discuss the elements of measuring systems? Please identify your answer with help of sketch?

c. Define measurement? And mention the basic information about measurement?

d. What are the factors that influence the choice of measurement devices? With a brief mention of both of them?

Question Number (2) (20 Points)

1- How to measure the following dimension by gage blocks

- **6.020 mm, 4,120mm**
- Select the gage blocks from the blow table.

عدد القوالب	أطوال القوالب(mm)	مقدار التزايد (الخطوة)(mm)
2	1.005من 1.01إلى	0.005
9	1.02من 1.10إلى	0.01
9	1.20من 1.90إلى	0.1
10	1من 10إلى	1
2	20من 30إلى	10
1	60	30

2- Describe the gages used in difficult transferring dimension and not available in ordinary measurement devices?

3- Compare between the following:

1) Indicating and recording element (mechanical movement, electromechanical movement, and electronic indication).
2) Mechanical amplification.
3) Fluid amplification.
4) Optical amplification.
5) Electrical amplification.

4- Discuss and explain your experimental project in this course?

Question Number (3) **(15 Points)**

a. A force transducer with sensitivity of **2mV/V** and maximum capacity of **50** ton is used in a platform scale. If the excitation of the sensor circuit is **5V**, obtain the force (ton)-output (volt) equation and calculate the sensor output if the vehicle weight was **30** ton.

b. In order to calculate the principal stresses in a test sample three strain gauges at used at different angles as shown in fig. (**1**). The following reading are obtained:

Gauge number	strain
1	$850*10^{-6}$
2	$-100*10^{-6}$
3	$350*10^{-6}$

Calculate the principal strains.

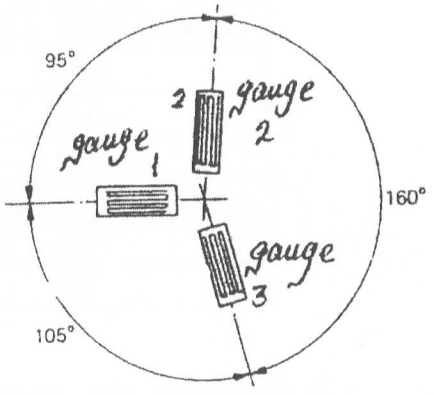

Fig. (**1**): Three strain gauges at three different angles.

Question Number (4) **(10 Points)**

i. Explain in details with simple drawing the **source of error in** measurement equipment;

ii. Define the calibration of measuring, and mention the steps of calibration?

iii. Explain in details with drawing the following **Torque measurement:**

a- Torque measurement by mechanical technique.

b- Torque measurement by electrical technique.

Dr. Eng. Maher . R. Elsadaty

with my best wishes

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TANTA UNIVERSITY
FACULTY OF ENGINEERING
DEPARTMENT OF MECHANICAL POWER ENGINEERING
SECOND YEAR STUDENTS OF PRODUCTION ENGINEERING & MACHINE DESIGN
COURSE TITLE: HEAT TRANSFER COURSE CODE: MEP2251

DATE: JUNE, 8-2019 SECOND TERM TOTAL ASSESSMENT MARKS: 70 TIME ALLOWED : 3 HOURS

Remarks: (answer the following questions; assume any missing data, steam and heat tables and charts are allowed)

Problem number (1) (14 Marks)

(a) A pipe is insulated to reduce the heat loss from it. However, measurements indicate that the rate of heat loss has increased instead of decreased. Can the measurements be right? **(3 Marks)**

(b) How does heat conduction differ from convection ? **(3 Marks)**

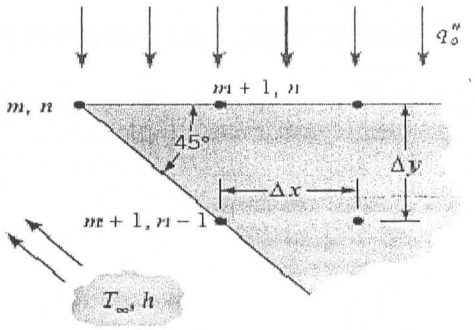
(c) Determine the loss of heat through the wall of a rotating sphere shaped boiling pan with an inner diameter d_i = 1.5 m and total boiler wall thickness δ = 20 cm. The inner surface temperature is 200 °C and that of the outer surface T_2= 50 °C. the equivalent thermal conductivity is 0.12 W/m.K. also find the heat flux at inside area. **(8 Marks)**

Problem number (2) (14 Marks)

a) What is the thermal contact resistance, how it can be reduced? **(4 Marks)**

b) A furnace of cubical shape, with external dimensions of 0.35 m, is constructed from a refractory brick (fireclay).If the wall thickness is 50 mm, the inner surface temperature is 600°C, and the outer surface temperature is 75°C, calculate the heat loss from the furnace. **(5 Marks)**

c) Derive the nodal finite-difference equation for the Node (m, n) at the tip of a cutting tool with the upper surface exposed to a constant heat flux q_o, and the diagonal surface exposed to a convection cooling process with the fluid at T and a heat transfer coefficient h. Assume $\Delta x=\Delta y$. **(5 Marks)**



Problem number (3) (14 Marks)

a) What is meant by a lumped capacity? What are the physical assumptions necessary for a lumped-capacity unsteady-state analysis to apply? **(3 Marks)**

b) Two pin fins are identical, except that the diameter of one of them is twice the diameter of the other. for which fin will the (a) fin effectiveness and (b) fin efficiency be higher? Explain. **(3 Marks)**

c) A 3 mm thick, 7.5cm long aluminum fin (k = 200 W/m.k) protrudes from a wall at 300 °C. The ambient temperature is 50 °C. The heat transfer coefficient (h) between the fin surface and air is

10 $W/m^2.k$. Calculate the heat loss from the fin per unit depth of material. Also, calculate the efficiency and effectiveness of the fin. **(8 Marks)**

Problem number (4) (14 Marks)

a) Steel balls 12 mm in diameter are annealed by heating to 1150 K and then slowly cooling to 400 K in an air environment for which T_∞= 325 K and h = 20 W/m^2 .K. Assuming the properties of the steel to be k = 40 W/m.K, ρ = 7800 kg/m^3, and c = 600 J/kg .K, estimate the time required for the cooling process. **(6 Marks)**

b) A 5-cm-high rectangular ice block (k = 2.22 W/m·K and $\alpha = 0.124 \times 10^{-7}$ m^2/s) initially at 220 °C is placed on a table on its square base 4 cm x 4 cm in size in a room at 18°C. The heat transfer coefficient on the exposed surfaces of the ice block is 12 $W/m^2 \cdot K$. Disregarding any heat transfer from the base to the table, determine how long it will be before the ice block starts melting. Where on the ice block will the first liquid droplets appear? **(8 Marks)**

Problem number (5) (14 Marks)

a) What is the *reciprocity relation* for view factors? What is the *summation rule*? **(3 Marks)**

b) How does radiosity for a surface differ from the emitted energy? For what kind of surfaces are these two quantities are identical? **(3 Marks)**

c) A cubical furnace 2 m on a side is used for heat treating steel plate. The top surface of the furnace consists of electrical radiant heaters that have an emissivity of 0.8 and a power input of 1.5×10^5 W. The sidewalls consist of a well-insulated refractory material, while the bottom consists of the steel plate, which has an emissivity of 0.4. Assume diffuse, gray surface behavior for the heater and the plate, and consider conditions for which the plate is at 300 K. What are the corresponding temperatures of the heater surface and the sidewalls? **(8 Marks)**

With my best wishes

EXAMINER DR. ELSAYED ELSAID

Tanta University

Department: Production Engineering & Mechanical Design
Total marks: 75 Marks

Faculty of Engineering

Course Title: Joining Of Materials
Course Code: MPD 2211
Year: 2rd Year Production

Final Exam

Date: 12-6-2019
Allowed time: 3 hrs.
No. of pages: 2

Q1. (15 Marks)

a) What are the advantages and disadvantages of welding compared to other types of assembly operations?

b) What is the fundamental difference between a fusion weld and a solid state weld?

c) Explain with drawing the meaning of the following welding symbol as shown in **Fig.1**?

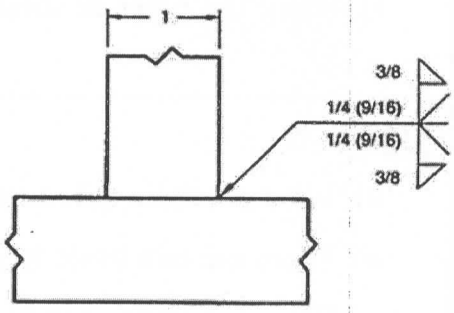


Fig.1

d) Explain with drawing the different zones in fusion weld joint and list the factors affect the size of every zone?

e) Explain the relation between the power density of heat source and the heat input to the work peace?

Q2. (15 Mark)

a) Describe the shielded metal arc-welding process.

b) What is the effect of cerium or thorium addition to the Tungsten electrode in the GTAW welding process?

c) Describe the different polarity which can be used in the GTAW welding process.

d) Describe the plasma arc-welding process.

e) Define the different modes of metal transfer in the GMAW welding process?

Q3. **(24 Mark)**

a) What is the main different between the SMAW and the FCAW?

b) Describe the SAW welding process.

c) Electro slag welding process has a significant disadvantage. What is that disadvantage?

d) Laser-beam welding and electron-beam welding are often compared because they both produce very high power densities. LBW has certain advantages over EBW. What are they?

e) List the advantages of the SSW over FW Processes?

f) Name the types of solid state welding processes.

Q4. **(21 Marks)**

a) What are the applications of the roll welding and diffusion welding?

b) There are two basic types of friction welding. Describe and distinguish the two types.

c) What are some of the important welding defects?

d) What are the three basic categories of inspection and testing techniques used for weldments? Name some typical inspections and/or tests in each category.

e) Name the different techniques used in the magnetic particle testing.

f) Describe the steps of the liquid penetrant testing method.

g) List the two types of the destructive testing methods?

With my best wishes

Dr. Eng. Saad .M. Ebied

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Tanta University
Engineering Faculty
2nd Year Production

بسم الله الرحمن الرحيم

Machine design
June 2019
Time : 4 hours

Answer all the follwing questions :

(1) - Two parallel shafts whose center lines are 4.8 m apart, are connected by an open belt drive. The diameter of the larger pulley is 1.5 m and that of smaller pulley 1.05 m. The initial tension in the belt when stationary is 3 KN. The mass of the belt is 1.5 Kg/m length. The coefficient of friction between the belt and the pulley is 0.3. Taking centrifugal tension into account, calculate the horse power transmitted, when the smaller pulley rotates at 400 r.p.m.

(2) -

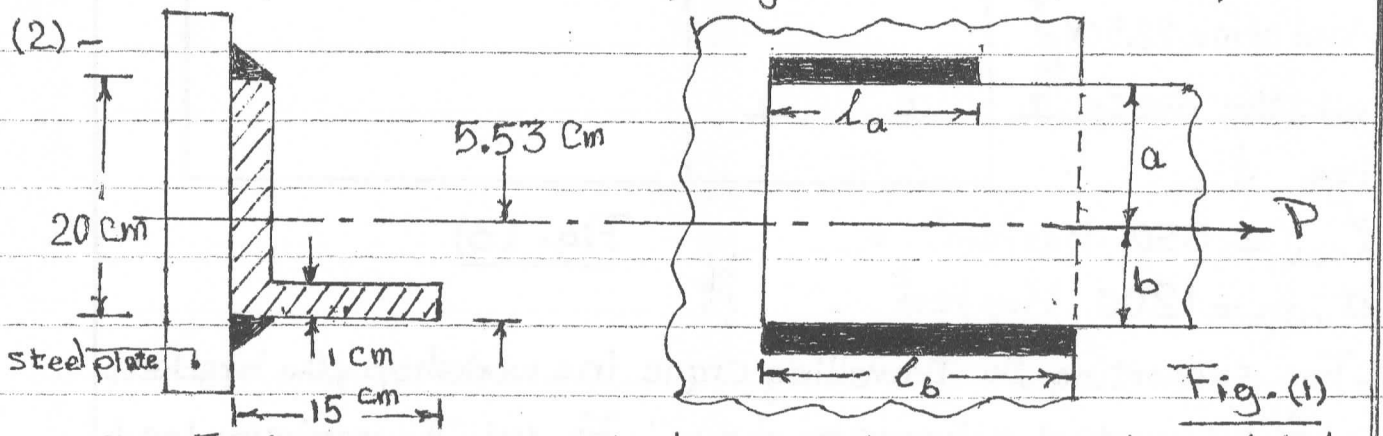

Fig. (1)

A 20x15x1 Cm angle is to be welded to a steel plate by fillet welds as shown in Fig. (1). If the angle is subjected to a static load of 20 Ton, find the length of the weld at the top and bottom. The allowable shear stress for static loading may be taken as 750 Kgs/cm^2.

(3)

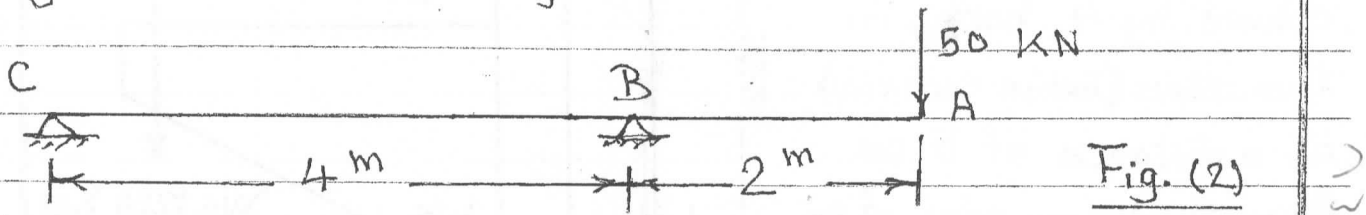

Fig. (2)

A beam ABC is subjected to load of 50 KN as shown in Fig. (2). Determine the deflection at point A and determine the maximum deflection of the beam between point B and point C. ($E = 200$ GPa & $I = 4 \times 10^{-4}$ m^4).

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(4)- An eccentrically load lap riveted joint is to be designed for a steel braket as shown in Fig. (3). The braket is 10 mms thick. All rivets are to be the same size. The loads on the braket are

$P = 1250$ Kgs

$Q = -1000$ Kgs.

The rivets spacing is $c = 50$ mms & load arm $= 22.5$ cm

Find the rivets size if

$\tau_{all.} = 650$ Kgs/cm^2 &

$\sigma_{all.} = 1200$ Kgs/cm^2.

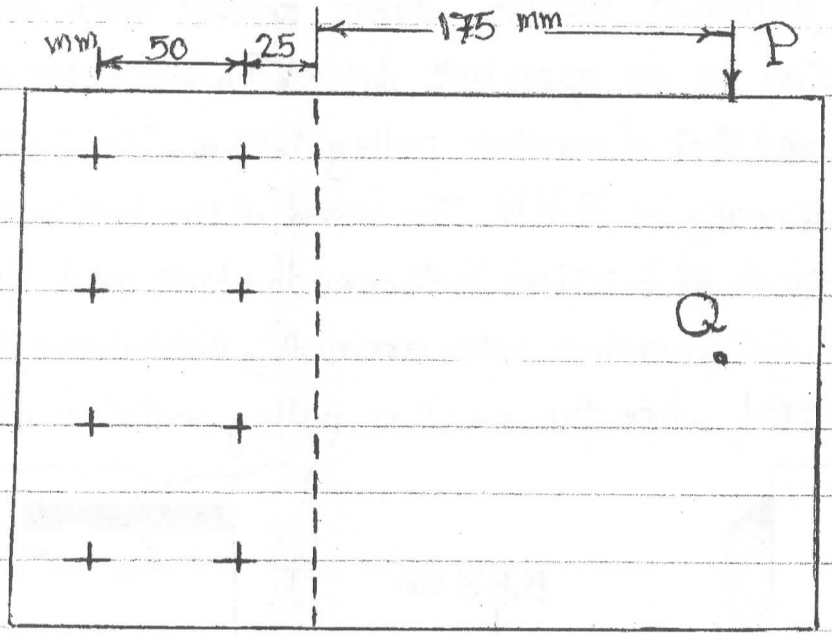

Fig. (3)

(5)- For supporting the Travelling crane in a workshop, the brackets are fixed on steel columns as shown in Fig. (4). The maximum load that comes on the braket is 1200 Kgs, acting vertically at a distance of 40 cms from the face of the column.

The vertical face of the bracket is secured to a column by 4 bolts, in two rows (Two in each row) at a distance of 5 cm from the lower edge of the bracket.

Determine the size of the bolts if the permissible value of the tensile stress for the bolt material is 840 Kgs/cm^2, Also find the cross-section of the arm of the bracket which is rectangular. $\tau_{all} = 650$ Kgs/cm^2.

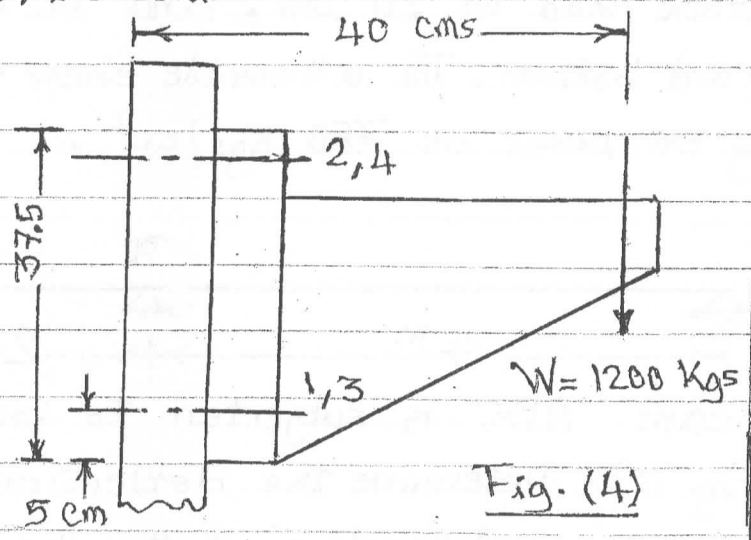

Fig. (4)