Tanta University	**Advanced Control Systems for Mechanical Applications** Course Code: MEP352 4th Level Mechatronics Engineering Program **Final Exam:** 40Marks (June 11, 2025)	Faculty of Engineering
Time Allowed: 2 hours		Mechatronics Program

Please answer the following questions:

Question (1) **(10 Marks)**

Find the number of poles in the right half side of the s-plane for a unity feedback closed-loop system, which has a feed forward transfer function $G(s)$, given as:

$$G(s) = \frac{1}{s(2s^4 + 3s^3 + 2s^2 + 3s + 2)}$$

Question (2) **(12 Marks)**

1. A feedback control system has the following open-loop transfer function:

$$G(s)H(s) = \frac{K}{(s+1)(s^2+s+1)}$$

   a) **Sketch** the root locus diagram for the closed loop system.
   b) **Find** marginal stability frequency.
   c) **Find** the value of K to give the dominant closed loop poles a damping ratio of $\zeta = 0.3$

2. To improve the steady state performance, the proportional controller is replaced by a proportional plus integral controller. The open-loop transfer function now becomes:

$$G(s)H(s) = \frac{K(s+2)}{s(s+1)(s^2+s+1)}$$

From the new characteristic eqn. of the system, prove that (without sketching the root locus diagram):

   a) The two break-away points occur at $\sigma_{b_1} = -0.623, \sigma_{b_2} = -2.53$
   b) The imaginary axis crossover occurs when $K = 0.464$

Question (3) (10 Marks)

1. **Draw** the Bode diagram (the logarithmic magnitude and phase angle curves) for the following transfer function:

$$G(s) = \frac{10(1+s)}{(0.2s+1)(5s+1)}$$

2. The magnitude plot of a transfer function:

$$G(s) = \frac{K(1+0.5s)(1+as)}{s(1+s/8)(1+bs)(1+s/36)}$$

is shown in Fig. 2. **Determine** K, a, and b from the plot.

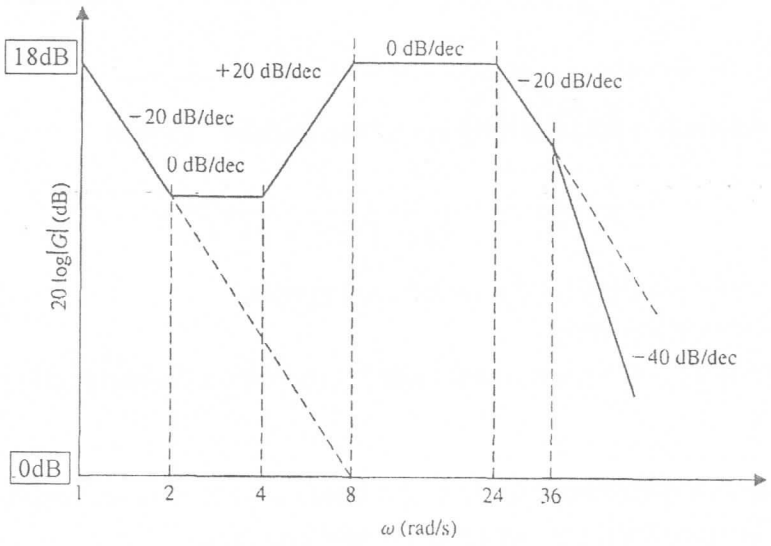

Fig. 2 Bode diagram for a unity feedback system

Question (4) (8 Marks)

Draw the polar plot for the following transfer function (for $K = 1$):

$$G(s) = \frac{K(s+2)}{s(s+1)(s+10)}$$

Best of Luck **Dr. Omar Mehrez**

Tanta University

Mechatronics Engineering Program
Total Marks: 40 marks

Faculty of Engineering

Course Title: Laboratory | **Course Code: MEP 357** | **No. of Pages:** 2 pages
Date: 23 June 2025 - Final Exam | **Allowed Time:** 2 hrs. | **4th Level**

ANSWER ALL THE FOLLOWING QUESTIONS
support your answer with illustrations whenever possible

Question (1) (5 Marks)

Indicate whether the following statements are true or false:

1. The flow rate through a control valve is inversely proportional to the square root of the pressure drop across it.
2. A check valve allows fluid flow in only one direction and prevents backflow in hydraulic circuits.
3. The speed of a double-acting cylinder can be controlled by adjusting the flow rate on both the extend and retract sides.
4. Tandem cylinders are commonly used in applications requiring multiple stages of extension, such as dump trucks.
5. SAE 100R1 hydraulic hoses have a single wire braid reinforcement layer.
6. Increasing the displacement of a hydraulic motor increases the torque output for a given flow rate.
7. Compressors will have higher efficiency if the compression follows an adiabatic process rather than an isothermal process.
8. Balanced vane pumps reduce radial loads on the shaft compared to unbalanced vane pumps.
9. A pressure intensifier can convert low-pressure hydraulic fluid into high-pressure fluid without increasing flow rate.
10. Hydraulic fluids with a high viscosity index have greater variation in viscosity over a wide temperature range.

Question (2) (8 Marks)

A) What are the benefits of using **electromagnetic relays** for pneumatic circuit control? **[1]**

B) The **boring tool** of an earth drill is driven by a hydraulic motor. The earth drill is lowered slowly by a hydraulic cylinder at a speed appropriate to the material to be drilled. The return stroke of the drill is to be executed as quickly as possible. This brief motion requires a higher volumetric flow of hydraulic fluid than the pump can deliver. This is produced by the additional installation of an accumulator. **Construct the hydraulic circuit of the boring tool, list its components, and describe its operation. [7]**

Question (3) (8 Marks)

A) Explain the construction and operation of **time delay valve. [2]**

B) Explain with sketch, a **pure pneumatic** circuit for speed control of **bidirectional motor. [4]**

C) Draw the **ISO symbols** of the following components: **[2]**

- **i.** Non-return valve.
- **ii.** Bidirectional hydraulic motor.
- **iii.** Adjustable pressure relief valve.
- **iv.** 5/2 double solenoid valve.

P.T.O >>>>

(8 Mar.

Question (4)

A) Mention the different types of **pipe layout** in pneumatic network. **[1]**

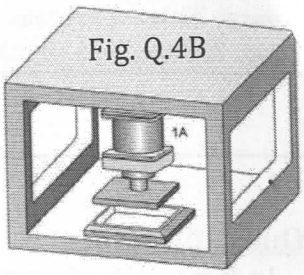

Fig. Q.4B

B) A plastic component is embossed using a die driven by a **double-acting cylinder**, Fig. Q.4B. The die is to advance and emboss the plastic when a push button is operated. The return of the die is to be affected when a preset pressure is reached. **Design an electro-pneumatic system that executes the desired control action. Provide a list of used components and explain how the circuit operates. [7]**

(11 Marks)

Question (5)

A) Illustrate the **pressure unloading valve's** construction, operation, and function and provide a hydraulic application (circuit) showing its functions. **[3]**

B) An endless **chain conveyor** (Fig. Q.5B) feeds the workpiece through a **painting booth**. A **hydraulic motor** drives the chain via a right-angle gear unit. Because of changes in the production process, the weight of the workpieces passing through the painting booth changes. The conveyor should **maintain a constant speed** whatever the load transmitted. **Do the following tasks: [8]**

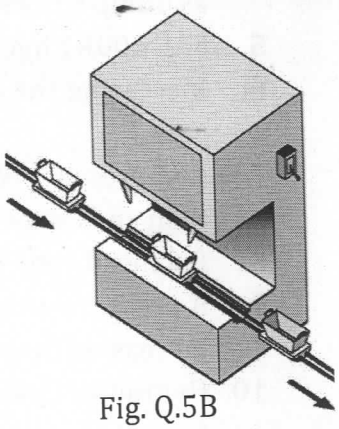
Fig. Q.5B

i. Select the suitable flow control valve (FCV) -type that meets the above requirements and draw its construction.
ii. Draw a hydraulic circuit to control the conveyor's speed.
iii. Explain circuit operation with both light and heavy workpieces (loads).
iv. Plot the pressure-flow rate characteristics of the selected FCV.

End of Questions **With my Best Wishes...** *Dr. M. Osama El-Samadony*

End of Exam

TANTA UNIVERSITY
FACULTY OF ENGINEERING
MECHATRONICS PROG.

MPD 311: MECHANICAL VIBRATIONS
4th LEVEL 2024-2025
DATE: 18/6/2025 TIME: 3 HOURS

FINAL TERM EXAM

Question 1 (20% Marks)

A spring-mass system of mass 4.5 kg and stiffness 7 KN/m oscillates on a rough plane, whose coefficient of friction is 0.15. If the initial amplitude is 25 mm. Find the amplitude after 5 cycles. If the rough surface is removed and viscous damping is placed instead. Find the coefficient of viscous damping necessary to give the same amplitude after 5 cycles.

Question 2 (20% Marks)

A rotating machine having a mass of 2000 kg rests on springs with a static deflection of 0.007 m. When the machine runs at 1000 rpm, the unbalance rotating force is 3300N. The ratio of two consecutive amplitudes in free vibration is 1 to 0.83, determine

a) The dynamic amplitude and the transmitted force at this speed.
b) What will happen to the amplitude and the transmitted force if the speed of the machine is reduced?

Question 3 (20% Marks)

A trailer has 1000 kg mass when fully loaded and 250 kg when empty. The spring stiffness is 350 KN/m. The damping factor is 0.5 when the trailer is fully loaded. The speed of the trailer is 100 km/hr. The road surface varies sinusoidally with a period of 5 m/cycle as shown in **Fig. 1**. Determine the amplitude ratio of the trailer when fully loaded and empty.

Question 4 (20% Marks)

A grinding wheel weights 100 N has an unbalance of 0.0015kg.m. The wheel is mounted on the center of a weightless shaft has a stiffness of 5 MN/m. The shaft is supported on two bearings each has a stiffness of 10 MN/m. Find the force transmitted to the bearing and the bending stress on 200 mm shaft length and 20 mm diameter at 9000 rpm.

Prof. Samy Issal

Question 5 (20% Marks)

Derive the dynamic equations of the system shown in **Fig. 2** using Lagrange's method and then find the natural frequencies, normal modes and mode shapes.

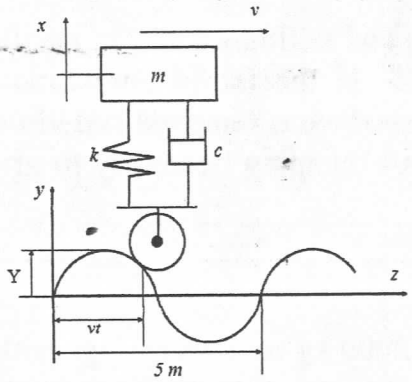

Fig. 1

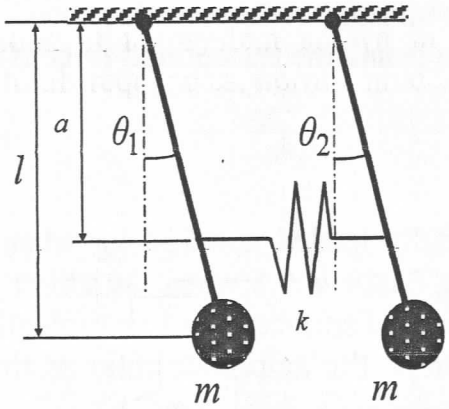

Fig. 2

Best Wishes,

Prof. Samy Assal

Tanta University

Time Allowed:2 hours

Engineering Mathematics (IV)

Course Code: EMP X14

FINAL Exam (50Marks)

(JUNE 11th, 2025)

Faculty of Engineering

Physics and Engineering Mathematics Dept.

Please answer the following questions:

Question (1) **(25 Marks)**

(a) The surfaces $f(x,y,z) = x^2 + y^2 - z^2 = 1$ and $g(x,y,z) = x + y + z = 5$ intersect in a curve c. Find the line tangent to c at the point $P_0(1,2,2)$.

(**Hint**: The tangent line to c at the point $P_0(1,2,2)$ is normal to both ∇f and ∇g at $P_0(1,2,2)$).

(b) Find a potential function for the conservative field $\boldsymbol{F} = 2\cos y\,\boldsymbol{i} + \left(\frac{1}{y} - 2x\sin y\right)\boldsymbol{j} + \frac{1}{z}\,\boldsymbol{k}$ and evaluate the line integral along any smooth curve $\boldsymbol{C}$ joining the point $a(0,2,1)$ to $b(1,\pi/2,2)$.

(c) Suppose a rigid body is rotating with constant angular velocity ω around the z axis. The position vector is $\boldsymbol{r}(t) = \rho\cos(\omega t + \phi_0)\,\boldsymbol{i} + \rho\sin(\omega t + \phi_0)\,\boldsymbol{j}$ for a given point on the rigid body. Find the velocity field $\boldsymbol{v}(t)$ and the circulation of $\boldsymbol{v}$.

(d) Integrate the function $f(x,y,z) = z$ over the upper half of the sphere of radius 2 defined by $\boldsymbol{r}(\phi,\theta) = 2\sin\phi\cos\theta\,\boldsymbol{i} + 2\sin\phi\sin\theta\,\boldsymbol{j} + 2\cos\phi\,\boldsymbol{k}, 0 \le \phi \le \frac{\pi}{2}, 0 \le \theta \le 2\pi$.

(e) Write the line L through the point $P = (2,3,5)$ and parallel to the vector $\boldsymbol{v} = (4,-1,6)$, in the parametric form. Find two points on L distinct from P.

Question (2) **(25 Marks)**

(a) Form the partial differential equation by eliminating h and k from the equation

$$(x-h)^2 + (y-k)^2 + z^2 = \lambda^2$$

(b) Find the integral surface of $x^2p + y^2q + z^2 = 0$ which passes through the curve

$$xy = x + y, z = 1.$$

(c) Solve the following partial differential equations:

i. $xyp + y^2q + 2x^2 = zxy$.

ii. $(3x + y - z)p + (x + y - z)q = 2(z - y)$.

iii. $2z + p^2 + qy + 2y^2 = 0$.

iv. $z_{xxx} - 7z_{xyy} - 6z_{yyy} = x^2 + xy^2 + y^3 + \cos(x - y)$

Best of Luck *Dr. Ali Mehrez and Dr. Mai Fathy Zidan*

Tanta University	Department of Electronics and Electrical Communication Engineering	Faculty of Engineering
Course Title: **Digital Signal Processing** Date: **Mon.,02-June-2025,**	Course Code: EEC302, Time Allowed: **3 hours,** Total Marks: **40** **Final Exam**	Students: **L4 Mechatronics** No. of Pages: **2**

Remarks: (answer the following questions… assume any missing data … arrange your answer booklet … Use graphs and examples whenever you have a chance during your answer). **Use only black or blue pens or pencils in your answer.**

Question 1: *(10 Marks)*

a) Consider a signal $x(t)$ is given by:

$$x(t)=u(t+\tau/2)-u(t-\tau/2)$$

Find the Fourier transform and sketch the spectrum of a signal $y(t)=x(t-t_0)$, and a signal $w(t)=e^{j\omega_0 t}x(t)$, where t_0 is a certain time delay and ω_0 is a certain frequency.

b) An analog signal $x(t)=5\cos(1500\pi t)-2\sin(3000\pi t)+\cos(8000\pi t)$ is sampled at a rate of 0.9 of the Nyquist rate.

i. Find the Nyquist rate
ii. Sketch the spectrum of $x(t)$
iii. Sketch the spectrum of the sampled signal.
iv. Sketch the spectrum of the recovered analog signal if an ideal low pass filter with cutoff frequency equals to the folding frequency is used.
v. Determine the aliasing noise frequencies.

Question 2: *(8 Marks)*

a) A certain DSP system has a sampling rate of $16\,KHz$, and it is equipped by a second order Butterworth anti-aliasing low-pass filter that has a cut-off frequency $6.8\,KHz$. Determine the percentage aliasing at cut-off frequency.

b) Draw circuit diagram for 3-bit flash converter ADC and the R-2R ladder DAC.

Question 3: *(12 Marks)*

a) Check the linearity, time invariance, and causality of the digital systems defined by the following difference equations:

i. $y(n)=5x(n-1)+2x(n-3)$
ii. $y(n)=2x(n+2)+nx(n)-0.5x(n-2)$

b) A sequence of a digitized signal as follows: $x(0)=1.0, x(1)=2.0, x(2)=-1.0, x(3)=-2.0$. The sampling frequency, $f_s=200\,Hz$.

i. Compute the frequency resolution and frequency bins.

ii. Compute the DFT of this signal using the given samples.
iii. Compute the Hanning window weights.
iv. Compute the DFT for the windowed sequence.

c) A sequence of a digitized signal is obtained by sampling at rate of 16 *KHz*. If the frequency resolution is required to be less than 2 *Hz*, determine the number of data points required for applying the FFT algorithm (assume that all the required data points are available).

Question 4: *(10 Marks)*

a) Two time domain sequences:
$x_1(n)=5\delta(n)+3\delta(n-1)$
$x_2(n)=2\delta(n)-\delta(n-1)$
determine the convolution of the two signals $(x(n)=x_1(n) * x_2(n))$ using the Z-transform (in Z and time domains).

b) Design a second order digital band-pass filter with the following specifications:
- Butterworth filter
- DSP system sampling frequency is 8 *KHz*
- Upper cut-off frequency is 2000 *Hz*
- Lower cut-off frequency is 1500 *Hz*

x(n)	X(z)
$\delta(n)$	1
$au(n)$	$\frac{az}{z-1}$
$nu(n)$	$\frac{z}{(z-1)^2}$
$n^2u(n)$	$\frac{z(z+1)}{(z-1)^3}$
$a^nu(n)$	$\frac{z}{z-a}$
$e^{-na}u(n)$	$\frac{z}{(z-e^{-a})}$
$na^nu(n)$	$\frac{az}{(z-a)^2}$
$\sin(an)u(n)$	$\frac{z\sin(a)}{z^2-2z\cos(a)+1}$

End of questions, Good luck
Assoc. Prof. Sameh Napoleon

Tanta University	**Advanced Control Systems for Mechanical Applications** Course Code: MEP352 4th Level Mechatronics Engineering Program **Final Exam:** 40Marks (June 11, 2025)	Faculty of Engineering
Time Allowed: 3 hours		Mechatronics Program

Please answer the following questions:

Question (1) **(10 Marks)**

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$$G(s) = \frac{1}{s(2s^4 + 3s^3 + 2s^2 + 3s + 2)}$$

Question (2) **(12 Marks)**

1. A feedback control system has the following open-loop transfer function:

$$G(s)H(s) = \frac{K}{(s+1)(s^2+s+1)}$$

   a) **Sketch** the root locus diagram for the closed loop system.
   b) **Find** marginal stability frequency.
   c) **Find** the value of K to give the dominant closed loop poles a damping ratio of $\zeta = 0.3$

2. To improve the steady state performance, the proportional controller is replaced by a proportional plus integral controller. The open-loop transfer function now becomes:

$$G(s)H(s) = \frac{K(s+2)}{s(s+1)(s^2+s+1)}$$

   From the new characteristic eqn. of the system, prove that (without sketching the root locus diagram):

   a) The two break-away points occur at $\sigma_{b_1} = -0.623, \sigma_{b_2} = -2.53$
   b) The imaginary axis crossover occurs when $K = 0.464$

Question (3) (10 Marks)

1. **Draw** the Bode diagram (the logarithmic magnitude and phase angle curves) for the following transfer function:

$$G(s) = \frac{10(1+s)}{(0.2s+1)(5s+1)}$$

2. The magnitude plot of a transfer function:

$$G(s) = \frac{K(1+0.5s)(1+as)}{s(1+s/8)(1+bs)(1+s/36)}$$

is shown in Fig. 2. **Determine** K, a, and b from the plot.

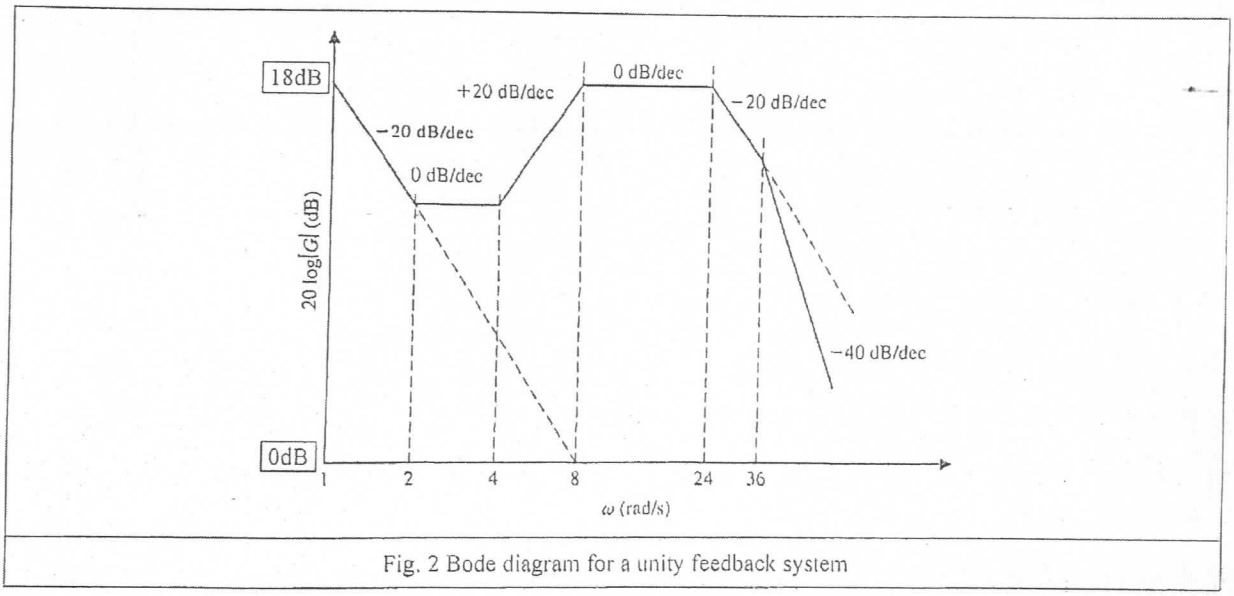

Fig. 2 Bode diagram for a unity feedback system

Question (4) (8 Marks)

Draw the polar plot for the following transfer function (for $K = 1$):

$$G(s) = \frac{K(s+2)}{s(s+1)(s+10)}$$

Best of Luck Dr. Omar Mehrez

لائحة قديمة				
اسم الماده	الأخلاقيات والتشريع		تاريخ الاختبار	2025/6/3
كود الماده	HUM XXX		زمن الاختبار	ساعين
عدد الصفحات	2		النهاية العظمى	40 درجه

أجب على الأسئلة التالية.

السؤال الاول (12 درجه)

أ. اذكر اربعة من مسنوليات المهندس تجاه المجتمع ؟

ب. اذكر اربعة من اخلاقيات علاقة المهندس ب رؤساءه

ج. عدد اوجهه حقوق الملكية الفكرية بين المهندس و زملائة

السؤال الثانى (12 درجه)

أ. ما هى الاعمال التى يجب على المهندس الا يقوم بها ؟

ب. كيف يحافظ المهندس فى اعمالة على البيئة و تحقيق التنمية المستدامة (اذكر اربعة)

ج. اذكر اطراف العقود الاهندسية المختلفة

السؤال الثالث (12 درجه)

اختر الاجابة الصحيحة مما يلى

a) يجب على المهندس اذا اراد ان يترك العمل ان يبلغ ..... قبلها بوقت كاف
أ. زملاءه ب. رؤساءه ج. عملاءه

b) ليس من عناصر المقايس الاساسية لاختيار مهندس لاعداد مشروع معيين ....
أ. درجته العلمية ب. مدى خبرتة العلمية ج. مدى كفاءتة الفنية

c) مقاول الباطن ....
أ. مرتبط بعقد مع المقاول ب. مرتبط بعقد مع المالك ج. غير مرتبط بعقد مع كل ما سبق

d) مده ضمان الاعمال الانشائية بعد الاستلام الابتدائى
أ. 10 سنوات ب. 6 شهور ج. عام

e) وحدة قياس الضوضاء
أ. الهرتز ب. كليو وات ج. الديسبل

f) التسليم النهائى للاعمال لايعنى ....

أ. استلام الاعمال قبل فتره ضمان الاعمال	ب. براءه زمة المقاول من العيوب الظاهره	ج. استرداد التامين للاعمال

g) تصنف ضوضاء الماتور على انها ....
أ. ضوضاء متقطعة ب. ضوضاء نبضى ج. ضوضاء مستمره

h) اذا كان مستوى ضوضاء ماكينه 170 ديسبل فعلى العامل إن يبتعد مساعة 30 متر تقريبا من هذه الماكينه ليعمل عند مستوى ضوضاء
أ. مساوى 80 ديسبل ب. اقل من 80 ديسبل ج. اكبر من 80 ديسبل

i) يجب على المهندس ان يوفر الى .....المناخ الملائم لمزاوله المهنة
أ. العملاء ب. مرؤسية ج. صاحب العمل

j) ..... على المهندس ان يمتنع عن استعمال المعدات و المواد و المعامل فى معملة الخاص
أ. يجب ب. لا يجب و. يجوز بعد اذن مرؤسية

k) يجب على المهندس يراعى ما يلى فى العروض الذى يقدمها على الاعمال
أ. زملاءه ب. الاجر المناسب ج. الاتفاق مع المقاول

l) المهندس الجوتقنى .....
ج. تخصص ميكانيكا د. مهندس عماره ج. تخصص مدنى

السؤال الرابع (4 درجه)

اختر(T) اذا كانت العباره صحيحة أو (F) اذا كانت العباره خاطئة مما يلى (20 درجة)

1. مجالات السلامة المهنية داخل المصانع والمرتبات والطائرات فقط
2. سبب حدوث حادثة هو وجود خلل بجميع عناصر نظام العمل مجتمعين
3. أحد الامثله فى ادراك العامل للمخاطر وابعادها "عند قيام سائق برحله من طنطا الى الاسكندرية لاحظ ان الفرامل الخاصة بالسياره لا تعمل بكافائتها فقام بعرض السياره على ميكانيكى فور عودته من رحلته بالسياره الى مدينه طنطا"
4. قد يساعد النظام الادارى على حدوث حوادث
5. الخصائص الانسانية للعامل قد تتغير مع العمر
6. لا يجوز للمهندس ان يقبل عمل اضافيا خارج هذه المؤسسة التى يعمل بها فى وقت فراغة
7. درجة المهندس العلمية هى المقاييس الاساسي لاختياره لاعداد مشروع معين
8. اذا مستوى ضوضاء ماكينة هو 95 ديسبل فعلى العامل ان يبتعد مسافة 32 مترا تقريبا من هذه الماكينة ليعمل عند مستوى ضوضاء 80 ديسبل او اقل

خالص التمنيات بالنجاح و التوفيق ا.د. ياسر السمدونى

Tanta University

Faculty of Engineeri

Department: Computers & Control Engineering

Total Points: 40 Points

Course Title: Computer Engineering II

Course Code: *CCE202*

MECHATRONIC PROGRAM FINAL EXAM

Exam Date: 21/06/2025(Second Term) Allowed time: 3 Hours No. of Pages: 3

Please answer all the following questions:

Question No.1 :(20 points divided as each statement takes a half point)

a—Choose the write answer (True or False) of each statement in the following table:

1-A computer is an electronic calculating machine that can have input data, microprocessors, as well as internal and external storing elements that can store instructions and help roducing the resulting suitable output data.	(True / False)
2-Binary information in a computer must be presented in a specific format where such task is performed by what so called an input unit.	(True / False)
3-Processor reads/writes to/from memory based on the memory address where the Random Access Memory (RAM) provides fixed access time independent of the location of the word.	(True / False)
4-Binary information must not be presented to a computer in a specific format. This task is performed by the input unit that Interfaces with input devices, accepts binary information from the input device, presents this binary information in a format expected by the computer, and transfers this information to the memory or processor.	(True / False)
5-A group of lines that serves a connecting path for several devices is called a bus. In addition to the lines that carry the data, the bus must have lines for address and control purposes.	(True / False)
6-The devices connected to a bus vary widely in their speed of operation where some devices are relatively hig h.	(True / False)
7-In order for a user to enter and run an application program, the computer must already contain some system hardware in its memory.	(True / False)
8-The speed with which a computer executes programs is affected by the design of its hardware and its machine language instructions.	(True / False)
9-Reducing amount of processing done in one basic step also makes it possible to reduce the clock period, P.	(True / False)
10-When the result of an arithmetic operation is outside the representable range, an arithmetic overflow has occurred.	(True / False)
11-Data lines of the external memory bus are connected to the internal processor bus via MDR where data may be loaded to (from) MDR from (to) internal processor bus or external memory bus..	(True / False)
12-Registers Y, Z, and TEMP are used by the processor for permanent storage during execution of some instructions.	(True / False)
13- At any one time, only one register may output its contents to the bus.	(True / False)
14-A tri-state gate can enter one of four output state so that its output can be in a logic low state (L), in a logic high state (H), and effectively an open-circuit (high impedance)	(True / False)
15-Data transfers and operations take place within time periods defined by the processor clock time period which is known as the clock cycle.	(True / False)
16-Arithmetic Logic Unit (ALU) is a purely combinatorial device that has memory or exnternal storage but it does have two input vectors as well one output vector which is usually denoted by F	(True / False)
17-It is possible to load multiple registers simultaneously from the bus where transfer the contents of register R3 to registers R4 and R7 simultaneously. .	(True / False)
18-Timing of the internal processor operations must be coordinated with the response time of memory Read operations where processor completes one internal data transfer in one clock cyclep	(True / False)
19-Add the contents of a memory location pointed to by Register R3 to register R1, i.e. ADD (R3), R	(True / False)

Please Turn the Page over

20-It is not allowed to activate the output gating signals of two registers on the bus at the same time.	(True / Fals
21-All general-purpose registers are combined into a single block called register file where it has three ports two of them work as outputs ports that connected to buses A and B that allowing the contents of two different registers to be accessed, simultaneously, and placed on buses A and B while the third one works as input port that allows the data on bus C to be loaded into a third register during the same clock cycle.	(True / False)
22-Recall that the updated contents of the PC are copied into Register Y in Step 2, not necessary for ADD instruction, but useful in BRANCH instructions where Branch target address is computed by adding the updated contents of the PC to an offset	(True / False)
23- It is not allowed to activate input (Rin) and output(Rout) gating signals of a specific register in the same step.	(True / False)
24-The disadvantage of using micro-programmed control is the fact that the task of designing the computer in the first place is simplified. Nevertheless, for certain applications hard-wired computers are still used. If speed is a consideration, hard-wiring may be required since it is faster to have the hardware issue the required control signals than to have a "program" do it.	(True / False)
25-Most modern computers use double bus arrangement for connecting I/O devices to CPU and Memory	(True / False)
26-The bus design is considered to be so easy because it needs a maximum bus speed that is largely limited by physical factors as well as the length of the bus and the number of connected devices. These physical limits prevent us from running the bus arbitrarily fast In addition, the need to support a range of devices with widely varying latencies and data transfer rates also makes bus design challenging.	(True / False)
27-Treatment of an interrupt-service routine is very similar to that of a subroutine except a subroutine performs a task that is required by the calling program while Interrupt-service routine may not have anything in common with the program it interrupts.	(True / False)
28-Multiple I/O devices may be connected to the processor and the memory via a bus while some or all of these devices may be capable of generating interrupt requests where each device operates independently, and hence no definite order can be imposed on how the devices generate interrupt requestsf	(True / False)
29-The device requesting an interrupt must identify itself directly to the processor and it can do so by sending a special code (4 to 8 bits) to the processor over the bus.	(True / False)
30-Direct Memory Access (DMA) controller can not performs functions that would be normally carried out by the processor for each word, it provides the memory address and all the control signals and is capable of transferring a block of data while incrementing the memory addresses as well as keeping track of the number of transfers.	(True / False)
31-Hardwired control generates control signals using a control step counter as well as coder/encode circuit.	(True / False)
32-Bus lines are grouped into three types named Data, Address, and Control.	(True / False)
33-Timing of data transfers over a bus can be worked as asynchronous where all devices derive timing information from a common clock line which has equally spaced pulses which define equal time intervals.	(True / False)
34-Data transfers via a synchronous bus can not be controlled by a handshake between the master and the slave. .	(True / False)
35-All cores are identical in an unsymmetric multi-core systems and they are not identical in asymmetric multi-core systems. Just as with single-processor systems, cores in multi-core systems may implement architectures such as superscalar, vector processing, or ultithreading.	(True / False)
36-The amount of performance gained by the use of a multi-core processor is strongly dependent on the hardware and its implementation.	(True / False)
37-A many-core processor is one in which the number of cores is lsmall enough that traditionalmulti-processor techniques are no longer efficient .	(True / False)
38-An asymmetric multi-core processor is one that has no multiple cores on a single chip and all of those cores are identical.	(True / False)
39-In a symmetric multi-core processor, the chip has multiple cores onboard, but the cores might be different designs. Each core will have different capabilities.	(True / False)
40-USB was not designed to standardize the connection of computer peripherals (including keyboards, pointing devices, digital cameras, printers, portable media players, disk drives and network adapters) to personal computers, both to communicate and to supply electric power. It has largely replaced interfaces such as serial ports and parallel ports, and has become commonplace on a wide range of devices.	(True / False)

Please See Next Page

Question No.2: (8 points divided as a=4, b=2, and c= 2 points)

a- State the most important parts of a computer.

b- Write the most important parts of the multiprocessor memories.

c- State the most important construction of a multi-core processor.

Question No.3: (4 points divided as a=2, b=2 points)

a- Give a definition and an example for each of:

1. A symmetric multi-core processor.
2. An asymmetric multi-core processor.

b- State in details the most important merits and immerits of using a microprogrammed control system

Question No.4: (8 points divided as a=3, b=3 , and c=2 points)

a- State the main difference between a subroutine and an-interrupt-service routine used in computer design system.

b- State in more details the differences that exist among single-core processor, multi-core, and many-core processors.

c- State the most advantages of using multi-core in computer's systems applications.

End of all Questions

Examiner: Prof. Dr. Mohamed Talaat Faheem

Tanta University	Production Engineering and Mechanical Design Department Total marks: 40 Marks	Faculty of Engineering
Course Title: Theory of Machines **Course Code:** MPD211 **Year:** 3rd Level Mechatronics Engineering	**Final exam**	**Date:** 19 / 06 / 2025 **Allowed time:** 3 Hours **No. of pages:** 2 pages

Solve the following questions

Q1- (8 Marks)

In the mechanism shown in Fig. 1, the crank OA rotates at 210 rpm clockwise. For the given configuration, determine the acceleration of the slider D and the angular acceleration of the link CD.

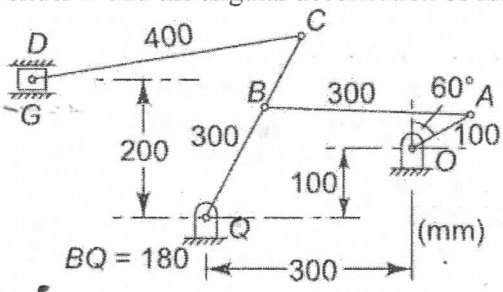

Fig. 1.

Q2- (8 Marks)

Determine the torque T_2 on link required to be applied for the static equilibrium of the mechanism shown in Fig. 2. The force P acting on the slider is 5000 N and the dimensions of the mechanism are as follows: $OA = 240\ mm$, $AB = 1000\ mm$, $BC = 620\ mm$, $CD = 400\ mm$ and $DE = 600\ mm$.

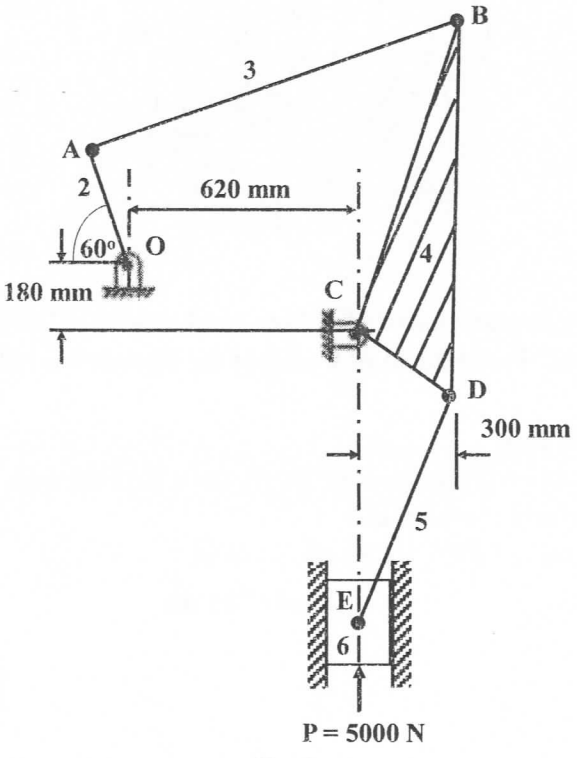

Fig. 2.

Q3- (8 Marks)

It is required to set out the profile of a cam with an oscillating follower for the following motion:

(a) Follower to move outward through an angular displacement of 20° during 90° of cam rotation;

(b) Follower to dwell for 45° of cam rotation;
(c) Follower to return to its original position of zero displacement in 75° of cam rotation; and
(d) Follower to dwell for the remaining period of the revolution of the cam.
The distance between the pivot center and the follower roller center is 70 mm and the roller diameter is 20 mm. The minimum radius of the cam corresponds to the starting position of the follower as given in (a). The location of the pivot point is 70 mm to the left and 60 mm above the axis of rotation of the cam. The motion of the follower is to take place with S.H.M. during outstroke and with uniform acceleration and retardation during return stroke.

Q4- (8 Marks)
In an epicyclic gear train, the internal wheels A and B and compound gears C and D rotate independently about the axis O. The gears E and F rotate on pins fixed to the arm G. E gears with A and C, while F gears with B and D as shown in Fig. 3. All the gears have the same module and the number of teeth are: $T_C = 28$; $T_D = 26$; $T_E = T_E = 18$; $T_A = 64$; and $T_B = 62$.
1. If the arm G makes 100 rpm clockwise and gear A is fixed, find the speed of the gear B; and
2. If the arm G makes 100 rpm clockwise and gear A makes 10 rpm counterclockwise, find the speed of the gear B.

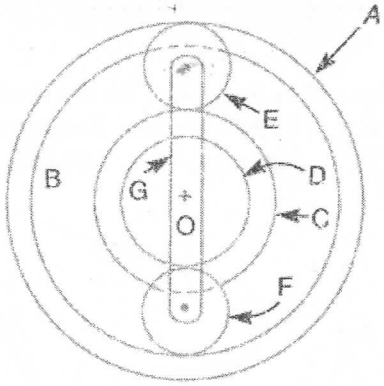

Fig. 3.

Q5- (8 Marks)
The equation of the turning moment curve of a three-crank engine is $(5000 + 1500 \sin 3\theta) N.m$, where θ is the crank angle in radians. The moment of inertia of the flywheel is 1000 $kg.m^2$ and the mean speed is 300 rpm. Calculate:

1. power of the engine, and
2. the maximum fluctuation of the speed of the flywheel in percentage when
   (i) the resisting torque is constant, and
   (ii) the resisting torque is $(5000 + 600\ sin\ \theta)\ N.m$.

End of exam

With best wishes
Dr. Abdelhameed Zayed

Tanta University	Production Engineering and Mechanical Design Department Total marks: 40 Marks	Faculty of Engineering
Course Title: Theory of Machines **Course Code:** PDE121 **Year:** 1st Level Mechatronics Engineering	**Final exam**	**Date:** 19 / 06 / 2025 **Allowed time:** 2 Hours **No. of pages:** 2 pages

Solve the following questions

Q1- (10 Marks)

In the mechanism shown in Fig. 1, the crank OA rotates at 210 rpm clockwise. For the given configuration, determine the acceleration of the slider D and the angular acceleration of the link CD.

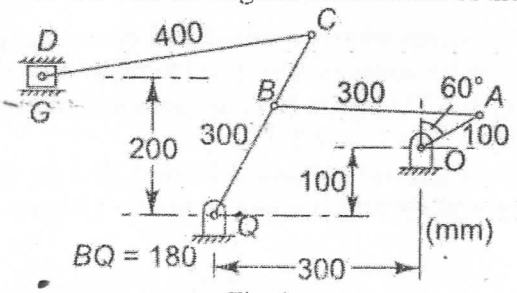

Fig. 1.

Q2- (10 Marks)

Determine the torque T_2 on link required to be applied for the static equilibrium of the mechanism shown in Fig. 2. The force P acting on the slider is 5000 N and the dimensions of the mechanism are as follows: $OA = 240\ mm$, $AB = 1000\ mm$, $BC = 620\ mm$, $CD = 400\ mm$ and $DE = 600\ mm$.

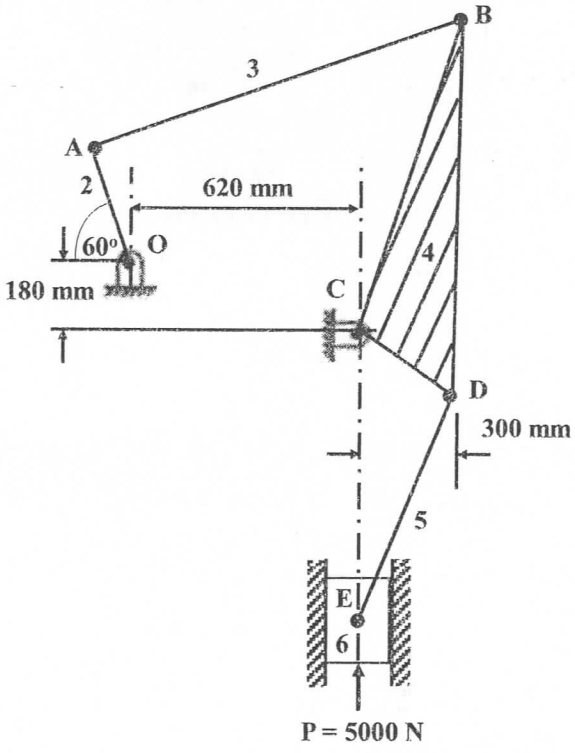

Fig. 2.

Q3- (10 Marks)

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1. If the arm G makes 100 rpm clockwise and gear A is fixed, find the speed of the gear B; and
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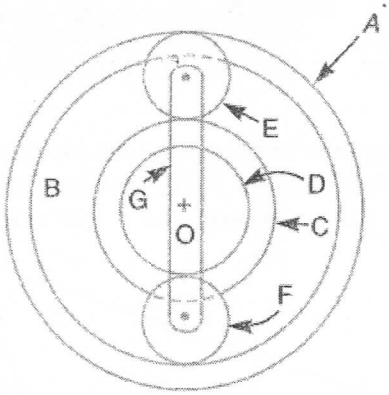

Fig. 3.

End of exam

With best wishes
Dr. Abdelhameed Zayed

لائحة جديده 2022				
اسم الماده	الاقتصاد الهندسى و دراسة الجدوى		تاريخ الاختبار	2025/6/15
كود الماده	ENG XE1		زمن الاختبار	ساعتين
عدد الصفحات	2		النهاية العظمى	50 درجه

يصرح للطالب باستخدام جداول الفائده المركبه.

- افترض أي بيانات ترى انها غير موجوده بالمسالة ويرجى ذكر كل افتراضاتك بوضوح
- أجب على جميع الأسئلة التالية.

السؤال الأول (15 درجه)

أ)- اذا اقترض شخص مبلغ ما من بنك بفائدة بسيطة مقدارها 10 % على ان يتم السداد خلال 4 سنوات فاذا كان إجمالى المبلغ الذى سيتم سداده 36000 $ أوجد قيمه القرض اذا كان سيتم سداد اصل القرض فى نهاية المده مع سداد الفوائد بشكل دورى خلال مده القرض؟

ب)- سافر عامل للعمل بالخارج و قام بأيداع مبلغ 2000 $ بالبنك بعد عامين من سفره للعمل بالخارج، ثم 1500 $ بعد عامين تاليين ثم 4000 $ بعد اربع اعوام تالية لاخر ايداع .اذا كان معدل الربح (الفائدة) بسيطة مقدارها 8 % .فكم يكون المبلغ الكلى للعامل لدى البنك بعد 10 سنوات من سفره؟

السؤال الثانى (10 درجه)

تقدم احدى شركات الاستثمار العقارى عرضا لبيع وحدة سكنية بمقدم 250000 جنيه و اقساط ربع سنوية لمدة 5 سنوات قيمة القسط الواحد منها 50 الف جنيه و كذلك ستة اقساط سنوية قيمة القسط الواحد منها 100000 تبدأ بعد سنتين من دفع المقدم . احسب ثمن الوحدة السكنية حاليا و كذلك ثمنها فى نهاية فترة التقسيط اذا كان سعر الاستثمار 12% سنويا

السؤال الثالث (15 درجه)

تدرس شركة ما بناء مصنع جديد و عرض عليها موقعان A and الجدول التالى يوضح بيانات التكاليف الثابتة و المتغيره لكل منهم على حده

التكاليف	B	A
تكاليف العمالة (جنيه/وحده)	10	11
تكاليف الانشاء (مليون جنيه)	4	3.9
تكاليف الخامات (جنيه/وحده)	5	6
تكاليف استهلاك الكهرباء ثابته سنويا (بالجنيه)	25000	26000
تكاليف الفوائد سنويا (بالجنيه)	5500	6000
تكاليف النقل (جنيه/وحده)	0.20	0.15
تكاليف العمالة الادارية سنويا (بالجنيه)	30000	28000

فاذا كانت فوائد القرض الذى ستمول به المشروع 10%

a) اختر الموقع ذو اقل تكلفه سنوية اذا كان حجم الانتاج السنوى 10000 وحده
b) احسب حجم الانتاج المناسب لكل موقع اذا كان الربح السنوى المطلوب 400000 جنية و كان سعر البيع للوحده 60 جنية
c) أوجد كمية االنتاج عند نقطة التعادل لكل موقع اذا كان سعر البيع للوحده 60 جنية

السؤال الرابع (10 درجه)

1. اذكر تكاليف التشغيل السنوية لمعدة ما ؟
2. - إذا اشترت إحدى الشركات معدة بمبلغ 9000 جنيه وكان عمره الإفتراضى 10 سنوات وسعر بيعه خرده 3000 جنيه و المعده تنتج 2000 وحده/عام أوجد ما يلى
   - القيمة الدفترية للمعدة فى السنة السادسة
   - معدل الاهلاك السنوى
3. ما هو مفهوم تكاليف الامتلاك لمعده وكيف يمكن حسابها
4. قارن بين الاستهلاك الوظيفى و الاستهلاك الطبيعى و الاستهلاك الادارى لمعده ما ؟

خالص التمنيات بالنجاح و التوفيق

أ.د. ياسر السمدونى

لائحة قديمة			
اسم الماده	اساسيات الاقتصاد الهندسى		تاريخ الاختبار	2025/6/15
كود الماده	أ***'		زمن الاختبار	ساعتين
عدد الصفحات	2		النهاية العظمى	40 درجه

يصرح للطالب باستخدام جداول الفائده المركبه.

- افترض أي بيانات ترى انها غير موجوده بالمسالة ويرجى ذكر كل افتراضاتك بوضوح
- أجب على جميع الأسئلة التالية.

السؤال الاول (12 درجه)

أ)- اذا اقترض شخص مبلغ ما من بنك بفائدة بسيطة مقدارها % 10 على ان يتم السداد خلال 4 سنوات فاذا كان اجمالى المبلغ الذى سيتم سداده 36000 $ أوجد قيمه القرض اذا كان سيتم سداد اصل القرض فى نهاية المده مع سداد الفوائد بشكل دورى خلال مده القرض؟

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السؤال الثانى (8 درجه)

تقدم احدى شركات الاستثمار العقارى عرضا لبيع وحدة سكنية بمقدم 250000 جنيه و اقساط ربع سنوية لمدة 5 سنوات قيمة القسط الواحد منها 50 الف جنيه و كذلك ستة اقساط سنوية قيمة القسط الواحد منها 100000 تبدأ بعد سنتين من دفع المقدم . احسب ثمن الوحدة السكنية حاليا و كذلك ثمنها فى نهاية فترة التقسيط اذا كان سعر الاستثمار 12% سنويا

السؤال الثالث (12 درجه)

تدرس شركة ما بناء مصنع جديد و عرض عليها موقعان A and الجدول التالى يوضح بيانات التكاليف الثابتة و المتغيره لكل منهم على حده

التكاليف	B	A
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فاذا كانت فوائد القرض الذى ستمول به المشروع 10%

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السؤال الرابع (8 درجه)

1. اذكر تكاليف التشغيل السنوية لمعدة ما ؟
2. - إذا اشترت إحدى الشركات معدة بمبلغ 9000 جنيه وكان عمره الإفتراضى 10 سنوات وسعر بيعه خرده 3000 جنيه و المعده تنتج 2000 وحده/عام أوجد ما يلى
   - القيمة الدفترية للمعدة فى السنة السادسة
   - معدل الاهلاك السنوى
3. ما هو مفهوم تكاليف الامتلاك لمعده وكيف يمكن حسابها
4. قارن بين الاستهلاك الوظيفى و الاستهلاك الطبيعى و الاستهلاك الادارى لمعده ما ؟

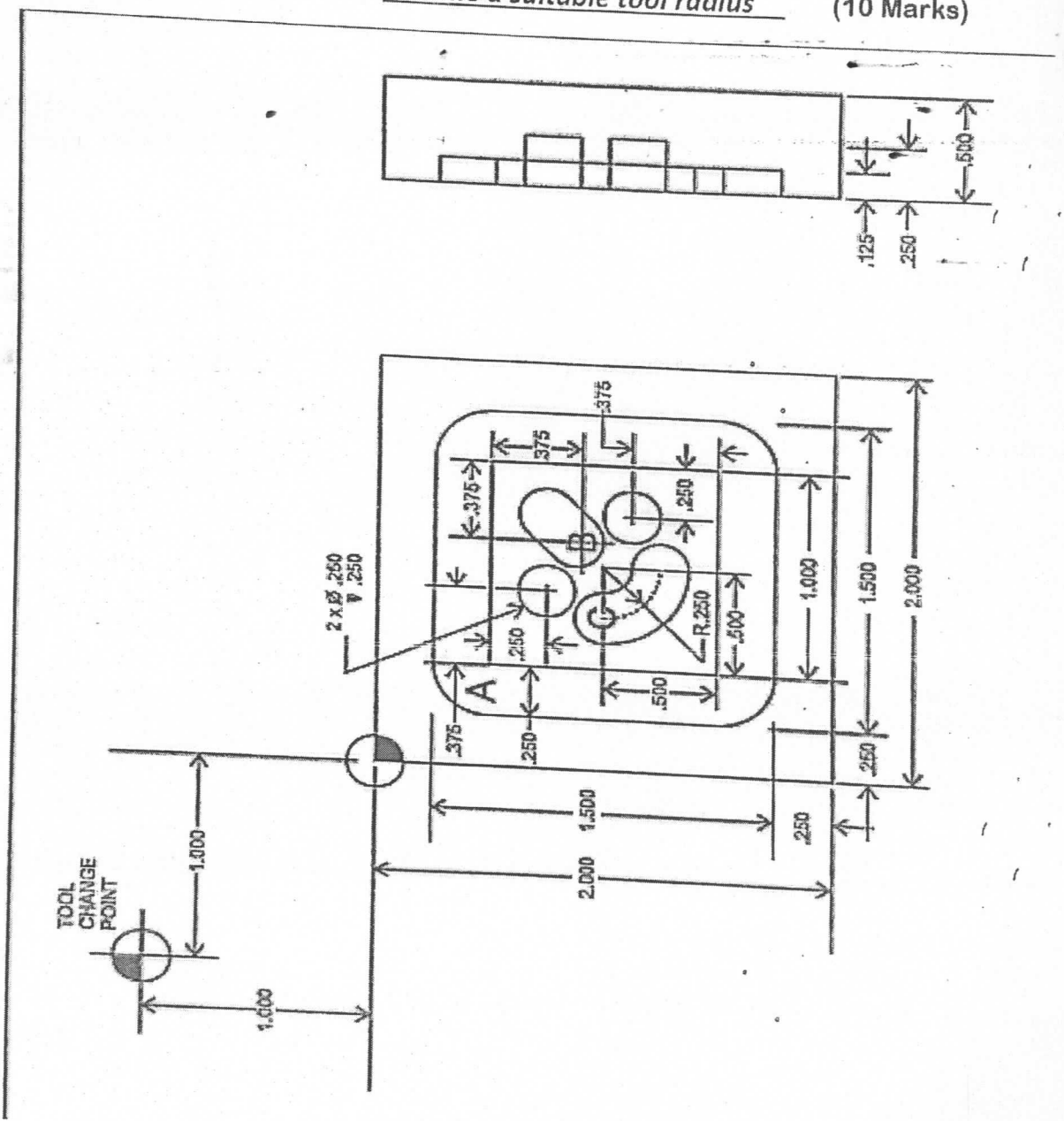
خالص التمنيات بالنجاح و التوفيق

أ.د. ياسر السمدونى

Tanta University	ماكينات التشغيل بالتحكم العددي (CNC)	Faculty of Engineering
First Term Exam	Level 4	Mechatronic Systems Engineering Dept.
Time Allowed: 3hrs	Course Code: MPD401	Date:25/05/2025
	Total Assessment Marks: 40	
	Dr. Eng. Ibrahim Eldeeb	

Answer all the following questions: **Assume any missing data**

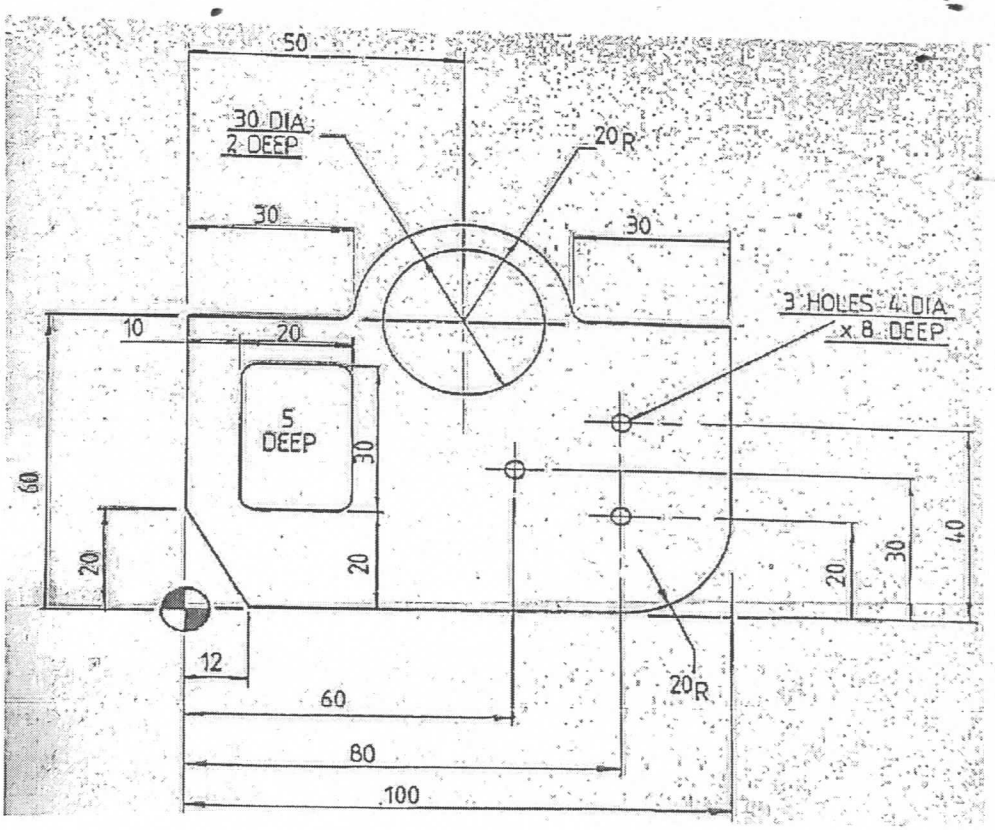
Question (1) Write program to produce workpiece 2X2 inch, it has different shapes as shown below. *Assume a suitable tool radius* **(10 Marks)**



مع تمنياتي بدوام التوفيق والنجاح

Tanta University	ماكينات التشغيل بالتحكم العددي (CNC)	Faculty of Engineering
First Term Exam	Level 4	Mechatronic Systems Engineering Dept.
Time Allowed: 3hrs	Course Code: MPD401	Date:25/05/2025
	Total Assessment Marks: 40	
	Dr. Eng. Ibrahim Eldeeb	

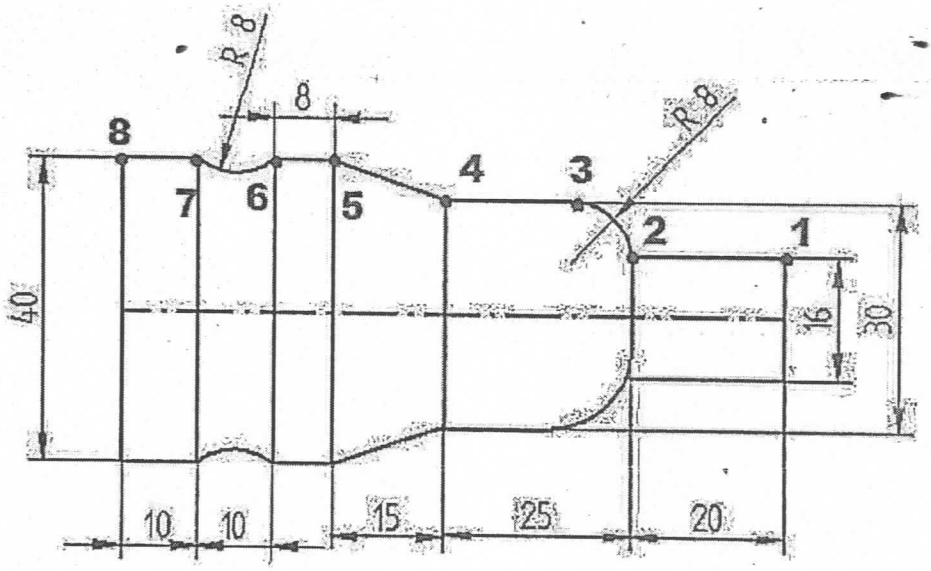
Question (2) Write down a full CNC part program for manufacturing the following Part using the following variables? Spindle speed 1000 RPM (clockwise), Feed rate=2 inch/min and tool No.3. [Mark 10]



مع تمنياتي بدوام التوفيق والنجاح

Tanta University	ماكينات التشغيل بالتحكم العددي (CNC)	Faculty of Engineering
First Term Exam	Level 4	Mechatronic Systems Engineering Dept.
Time Allowed: 3hrs	Course Code: MPD401	Date:25/05/2025
	Total Assessment Marks: 40	
	Dr. Eng. Ibrahim Eldeeb	

Question (3) Write a program to produce the workpiece shown in the figure below using turning operation, raw material is 40 mm in diameter and 88 mm in length. [Mark 10]



مع تمنياتي بدوام التوفيق والنجاح

Tanta University	ماكينات التشغيل بالتحكم العددي (CNC)	Faculty of Engineering
First Term Exam	Level 4	Mechatronic Systems Engineering Dept.
Time Allowed: 3hrs	Course Code: MPD401	Date:25/05/2025
	Total Assessment Marks: 40	
	Dr. Eng. Ibrahim Eldeeb	

Question (4) Draw the G-Code below with suitable scale. [Mark 10]

G21 G90 G40	G01 X60 Y45	G01 X125 Y0	G01 X210 Y50
G00 X0 Y0 Z5	G01 X60 Y27.5	G00 Z5	G01 X235 Y0
G00 Z0	G01 X85 Y27.5	G00 X130 Y0 Z5	G00 Z5
G01 X0 Y50	G01 X85 Y22.5	G00 Z0	G00 X210 Y27.5 Z5
G01 X25 Y25	G01 X60 Y22.5	G01 X130 Y50	G00 Z0
G01 X50 Y50	G01 X60 Y5	G01 X135 Y50	G01 X217.5 Y27.5
G01 X50 Y0	G01 X85 Y5	G01 X135 Y27.5	G01 X210 Y45
G01 X45 Y0	G01 X85 Y0	G01 X175 Y27.5	G01 X202.5 Y27.5
G01 X45 Y37.5	G01 X55 Y0	G01 X175 Y50	G01 X210 Y27.5
G01 X25 Y17.5	G00 Z5	G01 X180 Y50	G00 Z5
G01 X5 Y37.5	G00 X125 Y0 Z5	G01 X180 Y0	G00 X185 Y0 Z5
G01 X5 Y0	G00 Z0	G01 X175 Y0	G00 Z0
G01 X0 Y0	G01 X115 Y0	G01 X175 Y22.5	G01 X190 Y0
G00 Z5	G02 X115 Y50 R25	G01 X135 Y22.5	G01 X202.5 Y22.5
G00 X55 Y0 Z5	G01 X125 Y50	G01 X135 Y0	G01 X217.5 Y22.5
G00 Z0	G01 X125 Y45	G01 X130 Y0	G01 X230 Y0
G01 X55 Y50	G01 X115 Y45	G00 Z5	G01 X235
G01 X85 Y50	G03 X115 Y5 R20	G00 X185 Y0 Z5	G00 Z5
G01 X85 Y45	G01 X125 Y5	G00 Z0	M30

Assume any missing data

Good luck

End of Exam

With my best wishes

مع تمنياتي بدوام التوفيق والنجاح

Tanta University		Department: Mechatronics		Faculty of Engineering
Course Title: Dynamics of Mechanical Systems		Code: MEP 151	Level 1	
Date 25– 5 – 2025	Allowed time: 2 hrs	Full Marks: 40	No of Pages: 2	
Name: Prof. Dr. Mohamed Abdelgaied Ahmed			Final Exam	

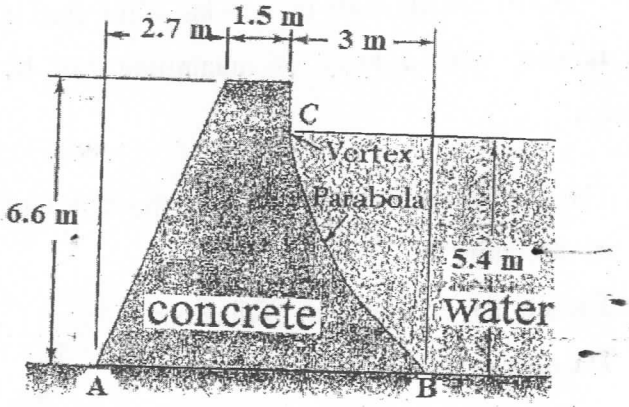
Answer the following questions:

Question No. 1 (Marks: 10)

For the concrete dam shown in Fig. Determine:

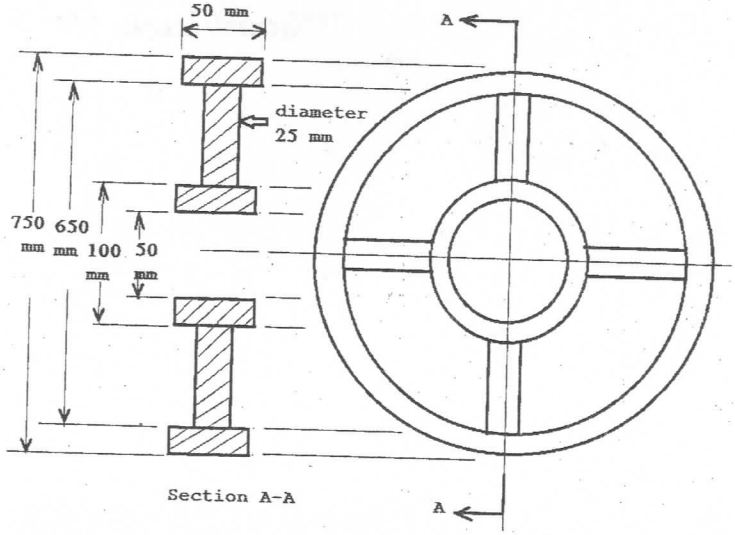
- The ground reaction.
- Result force of the water on BC.

Take the density of concreate 2400 kg/m^3 and the density of water 1000 kg/m^3. Also, the thick of dam is 1 m.



Question No. 2 (Marks: 10)

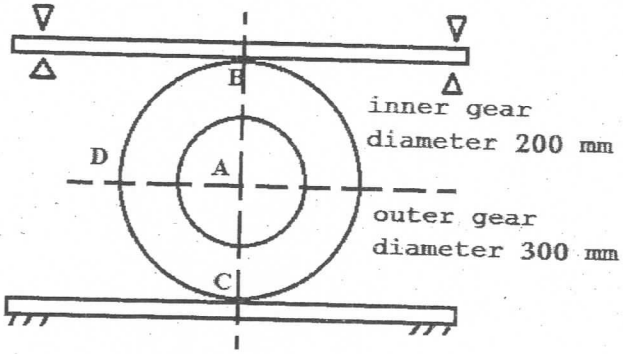
Figure shows a homogeneous wheel. If the density per unit volume of wheel materials are 1800 kg/m^3. Find the mass moment of inertia about the axis of the wheel.



Question No. 3 (Marks: 10)

The double gear shown rolls on the stationary lower rack, the velocity and acceleration of its center (A) are 1.2 m/s and 3 m/s^2 respectively directed to right. Determine:

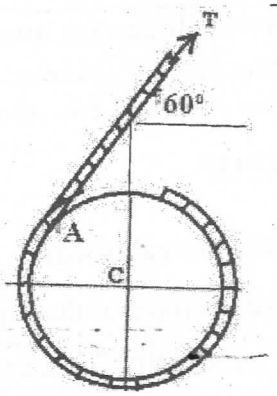
a) The angular velocity and angular acceleration of the gear.



b) The velocity of the upper rack R and of point D of the gear.

Question No. 4 (Marks: 10)

A cord is wrapped around a homogeneous disk of radius r = 0.5 m and the mass m = 15 kg. If the cord is pulled upward with a force of magnitude 180 N. Determine:



a) The acceleration at the center of the disk and its direction.
b) The angular acceleration of the disk.
c) The acceleration of the cord.

***Good luck. ***

Tanta University		Department: Mechatronics		Faculty of Engineering
Course Title: Dynamics of Mechanical Systems		Code: MEP 151	Level 2	
Date 25– 5 – 2025	Allowed time: 3 hrs Full Marks: 40		No of Pages: 2	
Name: Prof. Dr. Mohamed Abdelgaied Ahmed			Final Exam	

Answer the following questions:

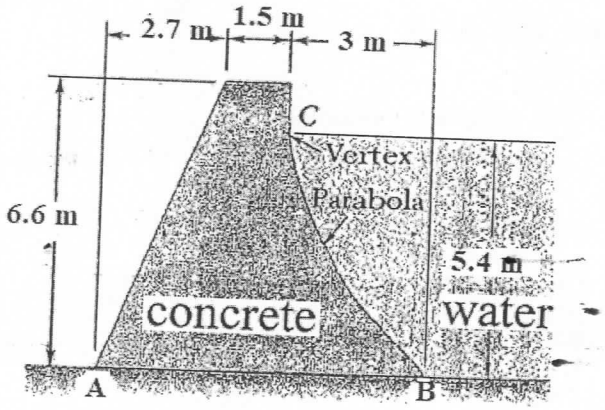
Question No. 1 (Marks: 8)

For the concrete dam shown in Fig.

Determine:

- The ground reaction.
- Result force of the water on BC.

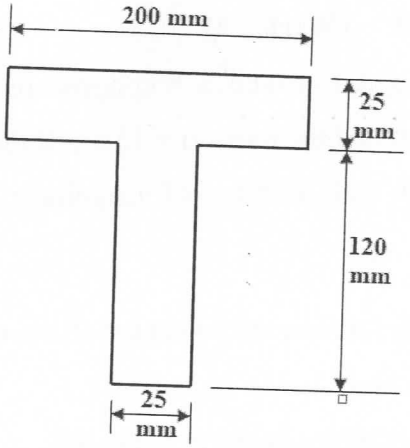
Take the density of concreate 2400 kg/m^3 and the density of water 1000 kg/m^3. Also, the thick of dam is 1 m.



Question No. 2 (Marks: 8)

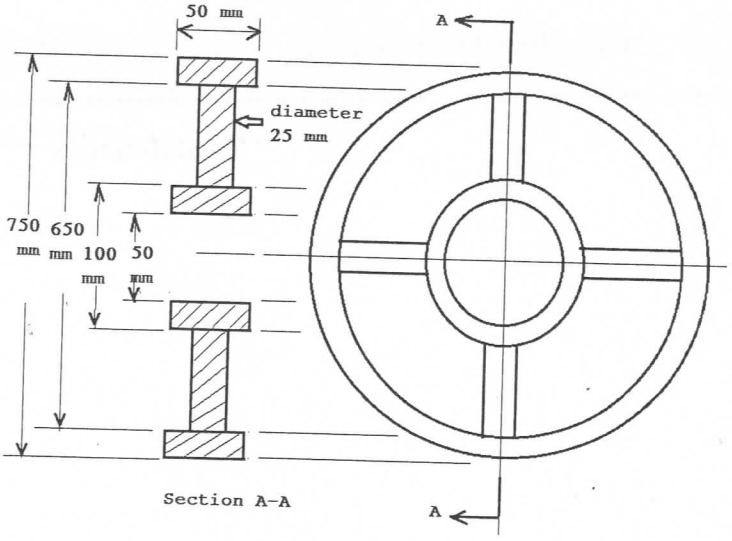
For T-section shown in Fig. Determine:

- The moment of inertia about the centroid axis.



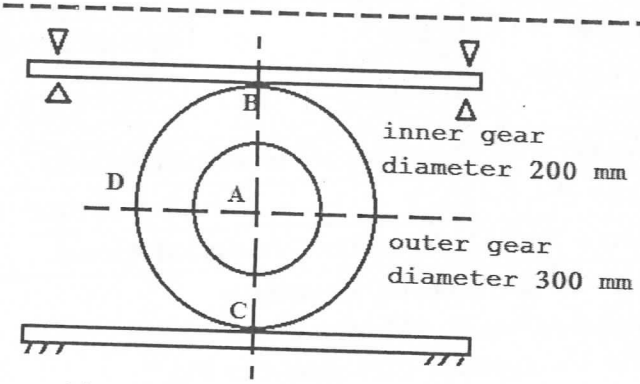
Question No. 3 (Marks: 8)

Figure shows a homogeneous wheel. If the density per unit volume of wheel materials are 1800 kg/m^3. Find the mass moment of inertia about the axis of the wheel.



Question No. 4 (Marks: 8)

The double gear shown rolls on the stationary lower rack, the velocity and acceleration of its center (A) are 1.2 m/s and 3 m/s^2 respectively directed to right. Determine:

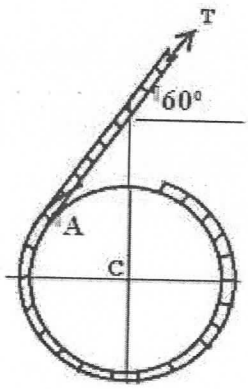


a) The angular velocity and angular acceleration of the gear.

b) The velocity of the upper rack R and of point D of the gear.

Question No. 5 (Marks: 8)

A cord is wrapped around a homogeneous disk of radius r = 0.5 m and the mass m = 15 kg. If the cord is pulled upward with a force of magnitude 180 N. Determine:



a) The acceleration at the center of the disk and its direction.

b) The angular acceleration of the disk.

c) The acceleration of the cord.

***Good luck. ***

Tanta University

Mechatronics Engineering Program
Total Marks: 40 Marks

Faculty of Engineering

Course Title: Digital Control Systems	**Course Code: CCE412**	**Level: 4**
Date: 26-5 -2025		**Allowed time: 3.0**

Question (1) (10 Marks)

a) Find the Z-transform of $e(t)=10t\ e^{-10t}$ if the sampling time ***T=0.1 sec***.

b) A function $e(t)=A\cos(\omega t)$ is sampled every $T=0.2$ sec. If the Z-transform of the resultant number sequence $e(kT)$ is given by:

$$E(z)=\frac{3z(z-0.6967)}{z^2-1.3934z+1}$$

Find the values of A and ω

Question (2) (15 Marks)

Consider a sampled-data system with input $e(k)$ and output $y(k)$ and is represented by the following difference equation:

$$y(k+2)-\left(\frac{3}{4}\right)y(k+1)+\left(\frac{1}{8}\right)y(k)=e(k)$$

where

$$e(k)=\begin{cases}1 & k=0,1\\ 0 & k\geq 2\end{cases} \qquad \text{and} \qquad y(0)=y(1)=0$$

Solve the given difference equation for $y(k)$ using:

i) The recursive technique.

ii) The z-transform.

iii) Discuss the system stability.

Question (3) (15 Marks)

Consider the closed-loop sampled-data system shown in Fig. 1. The sampling period T =1sec. The digital controller transfer function $D(z)=1$ and the plant transfer function $G_p(s)=\frac{1}{s(s+1)}$

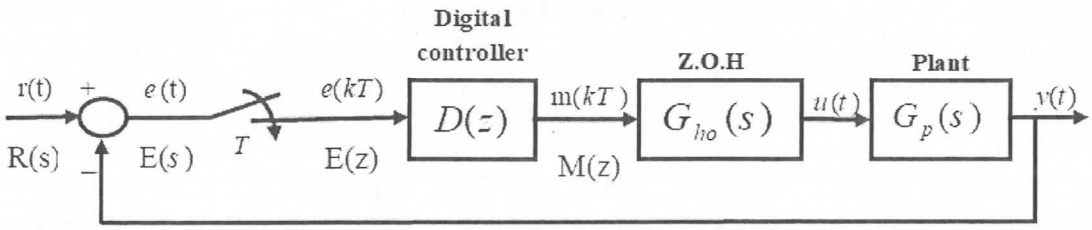


Fig. 1 The closed-loop sampled-data system

i) Find the open loop transfer function $\left(D(z)G(z)\right)$

ii) Find the closed loop transfer function $\dfrac{Y(z)}{R(z)}$

iii) Find $y(0)$ as $\left(\lim_{k\to 0} y(k)\right)$ when a unit step input is applied.

iv) Calculate the unit-impulse response.

v) Discuss the system stability.

Tanta University

Mechatronics Engineering Program
Total Marks: 40 Marks

Faculty of Engineering

Course Title: Digital Control Systems	**Course Code: CCE321**	**Level: 3**
Date: 26-5 -2025		**Allowed time: 2.0**

Question (1) (15 Marks)

Consider a sampled-data system with input $e(k)$ and output $y(k)$ and is represented by the following difference equation:

$$y(k+2)-\left(\frac{3}{4}\right)y(k+1)+\left(\frac{1}{8}\right)y(k)=e(k)$$

where

$$e(k)=\begin{cases}1 & k=0,1\\ 0 & k\geq 2\end{cases} \qquad \text{and} \qquad y(0)=y(1)=0$$

Solve the given difference equation for $y(k)$ using:

i) The recursive technique.

ii) The z-transform.

iii) Discuss the system stability.

Question (2) (25 Marks)

Consider the closed-loop sampled-data system shown in Fig. 1. The sampling period $T=1\text{sec}$. The digital controller transfer function $D(z)=1$ and the plant transfer function $G_p(s)=\dfrac{1}{s(s+1)}$

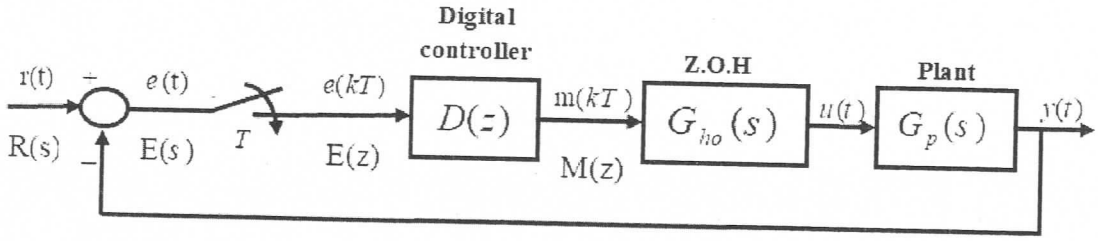


Fig. 1 The closed-loop sampled-data system

i) Find the open loop transfer function $\left(D(z)G(z)\right)$

ii) Find the closed loop transfer function $\dfrac{Y(z)}{R(z)}$

iii) Find $y(0)$ as $\left(\lim_{k\to 0} y(k)\right)$ when a unit step input is applied.

iv) Calculate the unit-impulse response.

v) Discuss the system stability.

Tanta University	Production Engineering and Mechanical Design Department Total marks: 40 Marks	Faculty of Engineering
Course Title: Mechanical Engineering Design **Course Code:** PDE221 **Year:** 2nd level Mechatronics. Eng.	**Final exam**	**Date:** 25 / 6 / 2025 **Allowed time:** 3 Hours **No. of pages:** 2 pages

Solve the following questions ***(Assume any missing data)***

Q1- An intermediate shaft of a gearbox, supporting two spur gears A and B and mounted between two bearings C_1 and C_2, is shown in Fig. 1. The pitch circle diameters of gears A and B are 500 and 250 mm respectively. The shaft is made of alloy steel with a permissible shear stress of 84 N/mm^2. The factors k_m and k_t are 1.5 and 2.0 respectively. The gears are keyed to the shaft. Determine the shaft diameter. **(8 Marks)**

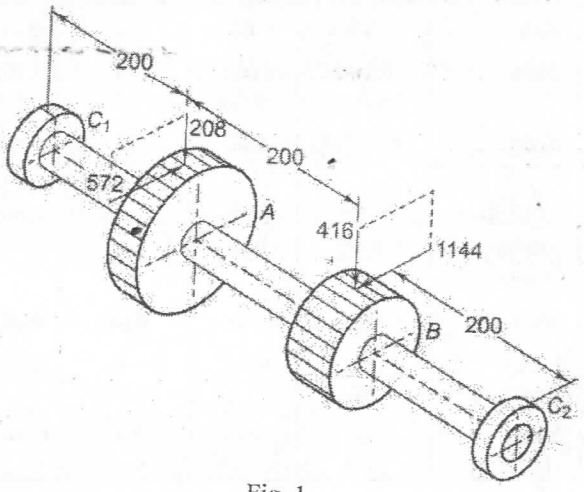
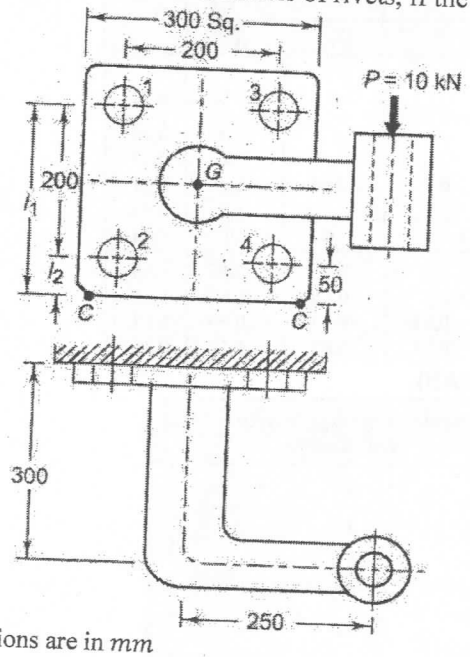


Fig. 1.

Q2- A rigid bracket subjected to a vertical force of 10 kN is shown in Fig. 2. It is fastened to a vertical stanchion by means of four identical bolts. Determine the size of the bolts by the maximum shear stress theory. The maximum permissible shear stress in any bolt is limited to 50 N/mm^2 **(8 Marks)**

Q3- A riveted joint, consisting of four identical rivets, is subjected to an eccentric force of 5 KN as shown in Fig. 3. Determine the diameter of rivets, if the permissible shear stress is 60 MPa. **(8 Marks)**



Dimensions are in mm

Fig. 2.

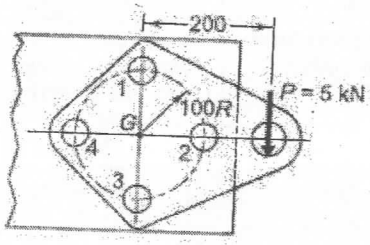


Fig. 3.

Q4- *Design a journal bearing for a centrifugal pump from the following data: Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.017 kg/m-s; Ambient temperature of oil = 15.5°C; Maximum bearing pressure for the pump = 1.5 N/mm². Calculate also the mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m²/°C.* **(10 Marks)**

Note that: **Design values for journal bearings.**

Machinery	*Bearing*	*Maximum bearing pressure (p) in N/mm²*	*Operating values*			
			Absolute Viscosity (Z) in kg/m-s	*ZN/p Z in kg/m-s p in N/mm²*	$\frac{c}{d}$	$\frac{l}{d}$
Railway cars	Axle	3.5	0.1	7	0.001	1.8 – 2
Steam turbines	Main	0.7 – 2	0.002 – 0.016	14	0.001	1 – 2
Generators, motors, centrifugal pumps	Rotor	0.7 – 1.4	0.025	28	0.0013	1 – 2
Transmission shafts	Light, fixed	0.175	0.025-	7	0.001	2 – 3
	Self -aligning	1.05	0.060	21		2.5 – 4
	Heavy	1.05		21		2 – 3
Machine tools	Main	2.1	0.04	0.14	0.001	1–4
Punching and shearing machines	Main	28	0.10	—	0.001	1–2
	Crank pin	56				
Rolling Mills	Main	21	0.05	1.4	0.0015	1–1.5

Q5- *A single row angular contact ball bearing number 310 is used for an axial flow compressor. The bearing is to carry a radial load of 2500 N and an axial or thrust load of 1500 N. Assuming light shock load, determine the rating life of the bearing.....* **(6 Marks)**

Note that: **Values of *X* and *Y* for dynamically loaded bearings.**

Type of bearing	*Specifications*	$\frac{W_A}{W_R} \le e$		$\frac{W_A}{W_R} > e$		*e*
		X	*Y*	*X*	*Y*	
Deep groove ball bearing	$\frac{W_A}{C_0}$ = 0.025	1	0	0.56	2.0	0.22
	= 0.04				1.8	0.24
	= 0.07				1.6	0.27
	= 0.13				1.4	0.31
	= 0.25				1.2	0.37
	= 0.50				1.0	0.44
Angular contact ball bearings	Single row	1	0	0.35	0.57	1.14
	Two rows in tandem		0	0.35	0.57	1.14
	Two rows back to back		0.55	0.57	0.93	1.14
	Double row		0.73	0.62	1.17	0.86

Values of service factor (*KS*).

S.No.	*Type of service*	*Service factor (K_s) for radial ball bearings*
1.	Uniform and steady load	1.0
2.	Light shock load	1.5
3.	Moderate shock load	2.0
4.	Heavy shock load	2.5
5.	Extreme shock load	3.0

With best wishes **End of exam** *Exam's committee*

Tanta University

Electrical Power and Machines Engineering Department

Faculty of Engineering

Course Title: **Power Electronics**	Course Code: **EPE212**	Year: **Two-Mechatronics (New)**
Date: 28/6/ **2025**	Allowed time: 2 **hrs**	No. of Pages: (2)
	Total Marks: **40 Marks**	

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

Question Number (1) **(10 Marks)**

[a] ***For bipolar junction transistors***

1) **Explain** the formation of the two types of transistors. **Show** your answer with figures and with current directions. **[5 Marks]**
2) **Plot** the characteristics of NPN transistor: circuit diagram, input characteristics, and output characteristics.
3) **Explain** in characteristics curves how transistors are working in different operating regions?

[b] ***For MOSFETs:***

1) **Explain**, with figures of circuit diagram and the basic structure, the n-channel and p-channel enhanced-type MOSFETs. **[5 Marks]**
2) **Explain**, with figures, the transfer characteristics of the n-channel and the p-channel enhanced-type MOSFETs.
3) **Explain**, with figures, the output characteristics of the n-channel enhanced-type MOSFETs, showing the three regions of operations.

Question Number (2) **(10 Marks)**

[a] If full-Wave rectifier with a center-tapped transformer has a purely resistive load of R, determine (a) the efficiency, (b) the FF, (c) the RF, (d) the TUF, (e) the PIV of diode D 1, (f) the CF of the input current, and (g) the input power factor PF. **[5 Marks]**

[b] Explain the operation of three-phase full-wave uncontrolled bridge rectifier.

1) Plot the circuit of three-phase full-wave bridge rectifier.
2) Plot the waveforms and conduction times of diodes including the line-to-line voltage, load voltage, load current, and the diode current.
3) Derive the value of: average output voltage, the RMS output voltage, the RMS value of diode current, the RMS value of transformer secondary current. **[5 Marks]**

Question Number (3) **(10 Marks)**

[a] Full-wave controlled bridge rectifier has an AC input of 120 V RMS at 60 Hz with a pure resistive load of 20 Ω. The delay angle is 40°. **Determine** the average current in the load, the power absorbed by the load, and the source voltamperes. **[5 Marks]**

[b] A single-phase full-bridge inverter has a resistive load of R = 2.4 Ω and the DC input voltage is V_s = 48 V. **Determine**: **[5 Marks]**

(a) The RMS output voltage at the fundamental frequency of the load voltage V_{o1},
(b) The output power P_o,
(c) the average and peak currents of each transistor,
(d) the average supply currents I_s.

Question Number (4) **(10 Marks)**

[a] A 100 V battery supplies RL load through a DC chopper (Buck). There is a freewheeling diode across the load that is composed of 0.4 H in series with 5 Ω resistor. Load current varies between 9A and 10 A. **[5 Marks]**

(a) **Plot** the circuit with R-L load and **plot** the waveforms of i/p and o/p voltages, i/p and o/p current, and freewheeling diode current. **Find:**
(a) The average load voltage, current and the chopper duty cycle
(b) The operating frequency f?
(c) The ripple current to maximum current ratio.

[b] A single-phase full-wave AC chopper has a resistive load R = 10 Ω and the output voltage is V_{Lrms} = 85 V (rms), 50 Hz. The firing angles of thyristor T1 and T2 are equal: $\alpha_1 = \alpha_2 = 90°$. **[5 Marks]**

(a) **Find** the input voltage is V_s the RMS
(b) **Find** the input power factor,
(c) **Find** the average and RMS values of the thyristor current.

End of questions. WISH YOU ALL THE BEST

Prof. Abdelsalam Ahmed *Assoc. Prof. Hossam Saleh*

Question Number (4) **(10 Marks)**

[a] **Explain** the operation of a DC Boost converter, and
(a) Plot the waveforms of i/p and o/p voltages, i/p and o/p current, (b) **Sketch** voltage and current waveforms for switch and diode. **[2 Marks]**

[b] A 100 V battery supplies RL load through a DC chopper (Buck). There is a freewheeling diode across the load that is composed of 0.4 H in series with 5 Ω resistor. Load current varies between 9A and 10 A. **[4 Marks]**
(a) **Plot** the circuit with R-L load and **plot** the waveforms of i/p and o/p voltages, i/p and o/p current, and freewheeling diode current. **Find:**
(a) The average load voltage, current and the chopper duty cycle
(b) The operating frequency f?
(c) The ripple current to maximum current ratio.

[c] A single-phase full-wave AC chopper has a resistive load R = 10 Ω and the output voltage is V_{Lrms} = 85 V (rms), 50 Hz. The firing angles of thyristor T1 and T2 are equal: $\alpha_1 = \alpha_2 = 90°$. **[4 Marks]**
(a) **Find** the input voltage is V_s the RMS
(b) **Find** the input power factor,
(c) **Find** the average and RMS values of the thyristor current.

End of questions. WISH YOU ALL THE BEST

Prof. Abdelsalam Ahmed *Assoc. Prof. Hossam Saleh*

Tanta University

Electrical Power and Machines Engineering Department

Faculty of Engineering

Course Title: **Power Electronics**	Course Code: **EPE202**	Year: **Three-Mechatronics (Old)**
Date: 28/6/ **2025**	Allowed time: 3 **hrs**	No. of Pages: (2)
	Total Marks: **40 Marks**	

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

Question Number (1) (12 Marks)

[a] ***For bipolar junction transistors*** **[4 Marks]**

1) **Explain** the formation of the two types of transistors. **Show** your answer with figures and with current directions.
2) **Plot** the characteristics of NPN transistor: circuit diagram, input characteristics, and output characteristics.
3) **Explain** in characteristics curves how transistors are working in different operating regions?

[b] ***For thyristors characteristics*** **[4 Marks]**

1) **Draw** Thyristor symbol, pn-junctions, and its cross section.
2) **Plot** and **explain** the V-I characteristics of the Thyristor showing its operation in different operating modes.
3) **Define** the latching current, holding current, and the avalanche breakdown of the Thyristor.

[c] ***For MOSFETs:*** **[4 Marks]**

1) **Explain**, with figures of circuit diagram and the basic structure, the n-channel and p-channel enhanced-type MOSFETs.
2) **Explain**, with figures, the transfer characteristics of the n-channel and the p-channel enhanced-type MOSFETs.
3) **Explain**, with figures, the output characteristics of the n-channel enhanced-type MOSFETs, showing the three regions of operations.

Question Number (2) (8 Marks)

[a] If full-Wave rectifier with a center-tapped transformer has a purely resistive load of R, **determine** (a) the efficiency, (b) the FF, (c) the RF, (d) the TUF, (e) the PIV of diode D 1, (f) the CF of the input current, and (g) the input power factor PF. **[4 Marks]**

[b] Explain the operation of three-phase full-wave uncontrolled bridge rectifier.

1) **Plot** the circuit of three-phase full-wave bridge rectifier.
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3) **Derive** the value of: average output voltage, the RMS output voltage, the RMS value of diode current, the RMS value of transformer secondary current. **[4 Marks]**

Question Number (3) (10 Marks)

[a] Full-wave controlled bridge rectifier has an AC input of 120 V RMS at 60 Hz with a pure resistive load of 20 Ω. The delay angle is 40°. **Determine** the average current in the load, the power absorbed by the load, and the source voltamperes. **[5 Marks]**

[b] A single-phase full-bridge inverter has a resistive load of R = 2.4 Ω and the DC input voltage is V_s = 48 V. **Determine**: **[5 Marks]**

(a) The RMS output voltage at the fundamental frequency of the load voltage V_{o1},
(b) The output power P_o,
(c) the average and peak currents of each transistor,
(d) the average supply currents I_s.

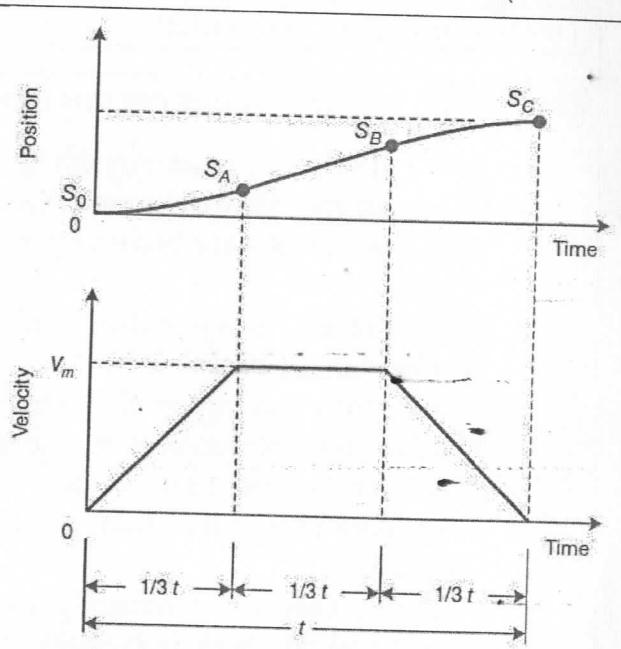
The third question (9 marks)

A. Draw the complete block diagram representing the closed-loop speed and position control of a permanent magnet DC motor. Show the required sensors and control loops.

(4 marks)

B. Given the velocity profile in the Figure where all segments have equal time, derive the formula for v_m as a function of t and Sc.

(5 marks)



Good Luck *Dr. Mohamed Almozayen*

Course	Servo Control Systems (MEP 356)		
Time	3 hours	Mark	40
Date	01 / 07 / 2025	Number of pages	2

Answer ALL the following questions:

The first question (16 marks)

*State if the following sentences are (**true**) or (**false**) and **correct the wrong answer**:*

1. Servo motors are primarily designed for open-loop control systems.
2. DC servo motors are characterized by high rotor inertia to improve stability.
3. AC servo motors are becoming less expensive to manufacture compared to PMDC motors.
4. The S-curve velocity profile eliminates jerk by smoothing transitions between acceleration phases.
5. A ball screw has higher efficiency compared to an ACME screw.
6. In a rack-and-pinion system, the transmission ratio is $N_{RP} = 1 / r_{pinion}$
7. A tachometer provides position feedback in a servo system.
8. Encoders can be either rotary or linear, with linear encoders directly measuring table position.
9. Stepper motors are commonly used in high-load CNC machining due to their high torque and feedback-free operation.
10. In a DC motor, the back EMF V_b is proportional to the armature current I_a.
11. The torque produced by a DC motor is given by $T_m = K_t \cdot I_a$, where K_t is the torque constant.
12. The electrical time constant of a DC motor is = J / B.
13. In a pure S-curve velocity profile, the acceleration is constant during the curved segments.
14. For a belt-drive system, the inertia of the load pulley J_{LP} is reflected to the motor shaft as $J_{LP} / (N_{BD})^2$.
15. In a ball-screw transmission, the lead is defined as the distance the nut travels per screw revolution.
16. In a trapezoidal velocity profile, the acceleration phase has zero jerk.

The second question (15 marks)

A	Compare between the NC and CNC machines.	**(3 marks)**
B	A 100 lb load will be positioned using a steel ball-screw with 0.28 lb/in^3 density, 0.375 in diameter, 36 in length, 0.75 in/rev lead, and 90% efficiency. The carriage weighs 0.47 lb. Calculate the inertia reflected by the transmission to its input shaft.	**(4 marks)**
C	A conveyor has 3 boxes of finished products on it. Each box weighs 20 kg. The two main rollers have $J_{roller} = 2.33 \times 10^{-3}$ kg-m^2 inertia each and dr = 8 cm diameter. The conveyor has several idler rollers to support the weight on the belt but the idler inertia are negligible. The belt weighs 5 kg. The velocity profile of the desired motion is ta = td = 100 ms, tm = 1 s, the belt speed is Vmax = 0.5 m/s. The belt friction coefficient is μ = 0.2 and the conveyor efficiency is η = 0.8. - Calculate the reflected inertia to the motor shaft. - Calculate the motor peak and RMS torques.	**(8 marks)**

---- *Please turn the page* ----

18) The range of decimal numbers that can be written in 6-bits sign magnitude form:
a) -31 to 31
b) 0 to 64
c) -32 to 31
d) -64 to 64

19) S-R type flip-flop can be converted into D type flip-flop if S is connected to R through:
a) OR gate b) AND gate c) Inverter
d) NOR gate e) None of These

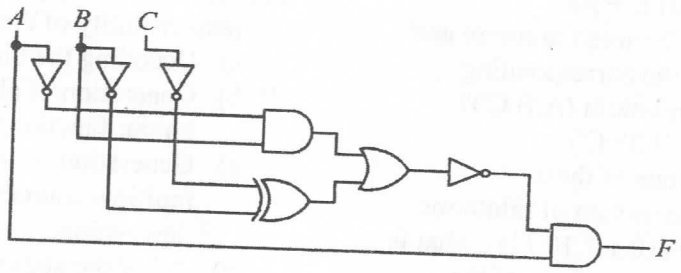
20) Which of the following circuits come under the class of combinational logic circuits?
a) Register b) Decoder
c) J-K flipflop d) Counter

Question (2): (Total : 20 Marks)

1) Using a Karnaugh map, find minimal SOP and POS expressions for
$F(A,B,C,D) = A\cdot B\cdot C + B'\cdot C\cdot D' + A\cdot D + B'\cdot C'\cdot D'$ **(Marks: 4)**

2) Implement the following Boolean function with an **8-to-1 multiplexer**.
$f(A, B, C, D) = \Sigma m(2, 4, 6, 9, 10, 11, 15)$ **(Marks: 4)**

3) Convert the following circuit to use only 2-input NOR gates. Minimize the final circuit by using as few NOR gates as possible. Do not minimize the original circuit.



(Marks: 4)

4) Draw 4-bit circular shift right register with using external signal for controlling shifting operation. **(Marks: 4)**

5) Design synchronous 4-bits binary down counter using clocked T flip-flops. **(Marks: 4)**

Good Luck

Examiners: Prof.(Assoc.) Dr. Mahmoud Alshewimy

Tanta University

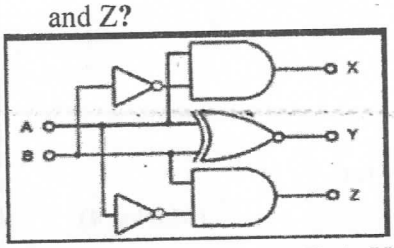
Department: Mechatronics Engineering Program
Total Marks: 40 Marks

Faculty of Engineering

Course Title: **Computer Engineering** Course Code: **CCE212** Level: **Two**
Date: **01/07/2025 (Final)** Allowed time: **2:00 hrs** No. of Pages: **(2)**

Question (1) (Total : 20 Marks)

1) Refer to the following figure. If A = 0 and B = 1, what will be the logic states at X, Y and Z?



a) X=1, Y=1, Z=0 b) X=1, Y=0, Z=0
c) X=0, Y=0, Z=1 d) X=0, Y=1, Z=0

2) The function **F(A, B, C) = ∑(1, 2, 3, 5, 7)** is equivalent to
a) $\bar{C} + \bar{A}B$ b) $C + AB$
c) $C + \bar{A}B$ d) $\bar{C} + AB$

3) Using the relation between minterm and maxterm, what is the corresponding maxterm for the minterm (A.B.C')?
a)(A'+B'+C) b)(A'+B'+C')
c) (A+B'+C) d)None of these

4) Given the function as sum of minterms F(A,B,C,D) = ∑ m (0,1,7,10,11) , what is the product of maxterms form of the function?
a) Π M (9,10,12,13,14)
b) Π M (2,3,4,5,6,8,9,12,13,14,15)
c) Π M (4, 5,6,7,11,12,13,14)
d) None of theses

5) Simplify F = ∑ m (2,4,5,7) , using maps.
a) AB\+ AC+ A\BC\ b)AB\+ABC\
c) AC+AB\C d) None of these

6) A full-adder has a Cin = 1. What are the sum ( ) and the carry (Cout) when A = 1 and B = 1?
a)sum= 0, Cout = 0 b)sum= 0, Cout = 1
c) sum= 1, Cout = 0 d)sum= 1, Cout = 1

7) An n to 2^n decoder outputs are:
a) n minterms of the input variables
b) 2^n minterms of the input variables
c) n product terms of the input variables
d) None of these

8) The problems of encoder are:
a) Its high price and low speed
b) Having all 0's and more than one 1's in the input pattern
c) Its complexity and large space
d) None of these

9) The signed magnitude number 11001100_2 is equivalent to
a) -76_{10} b) 204_{10}
c) CC_{16} d) 1212_{10}

10) What is the decimal value of the hexadecimal number 777?
a) 191 b) 1911
c) 19 d)19111

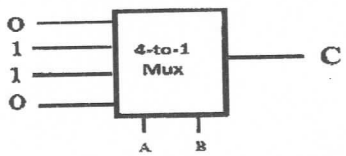
11) The binary number equivalent to the decimal number 151.75 is.....
a) 10000111.11 b) 11010011.01
c) 00111100.00 d) 10010111.11

12) **Simplify Y = A B' + (A' + B)C :**
a) A B' + C b) AB + AC
c) A'B + AC' d) AB + A

13) Which is the major functioning responsibility of the multiplixer circuit?
a) Decoding the binary information.
b) Generation of all minterms in an output function with OR-gate.
c) Generation of selected path between multiple sources and a single destination.
d) All of the above.

14) To operate correctly, starting a ring counter requires:
a) clearing all the flip-flops
b) presetting all the flip-flops
c) presetting one flip-flop and clearing all the others
d) clearing one flip-flop and presetting all the others

15) What is the gate represented using the given multiplexer circuit.



a) AND b) OR c) XOR d) XNOR

16) A J-K flip-flop with J = 1 and K = 1 has a 20 kHz clock input. The Q output is 10kHz.
a) True b) False

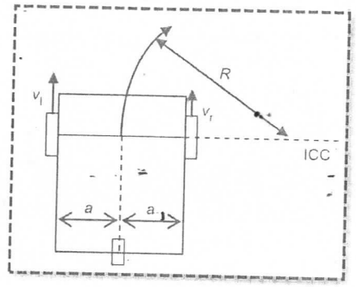
17) The synchronous input only can be used to set the flip-flop to either 1 or 0 state.
a) True b) False

Tanta University	**Advanced Robotics** Course Code: MEP/CCE452 Mechatronics Program **Final Exam** Total Marks: 40 – June 11, 2025	Faculty of Engineering
Time Allowed: 3hours		Mechanical Power Eng. Dept.

Answer the Following Questions: **4 Questions in 3 Pages**

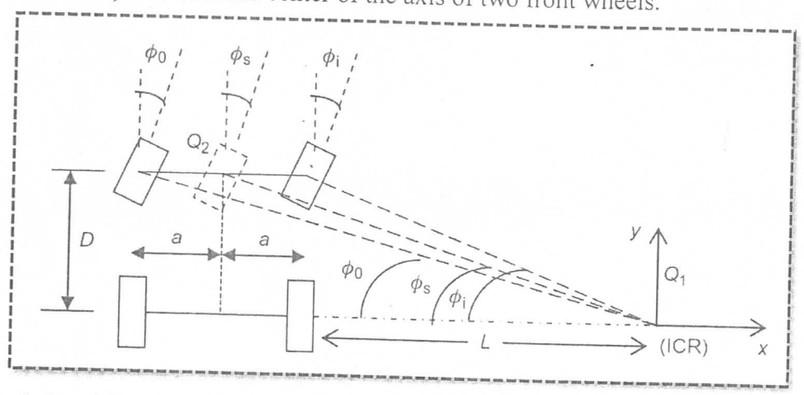
Question No. (1): **[10 Marks]**

1- For the mobile robot that has the opposite schematic diagram, **calculate** the instantaneous radius of the curvature (R) if the left and right wheels velocities are 10 m/sec and 20 m/sec respectively and the robot base width (distance between right and left sides) is 80 cm and **determine** the direction of the motion of the robot. **(2Marks)**



2- For the mobile robot that has the below schematic diagram, if wheelbase of the vehicle (D) is 70 cm, the distance between the rear (back) wheels is 50 cm and distance from the right rear (back) wheel to the center of rotation (L) is 100cm: **(4 Marks)**

a. Define the meaning of the instantaneous center of rotation (ICR).
b. **Calculate** the steering angle (ϕ_s)
c. Calculate the instantaneous center of rotation (ICR) distance from the center of each wheel (inner and outer front ones) and from the center of the axis of two front wheels.



3- For a four-wheeled mobile robot: **(4 Marks)**

a. Draw the **block diagram** for the mobile robot motion control system to control the robot linear and angular velocities.
b. Determine the **inputs and the outputs** of the controller and the robot.
c. Suggest the **type of the sensors** used to measure the robot outputs
d. Suggest the **type of the controller** to be used to control the robot for trajectory tracking.

Question No. (2): **[10 Marks]**

A- True or False and correct the False ones? **(5 Marks)**

1) A non-holonomic vehicle can travel in every direction and function in tight areas.
2) In differential drive mobile robots, the two wheels are driven by one motor .
3) Skid steering drive consists of two combined driven rear wheels and two combined steered front wheels.
4) Mobile robots may be classified into wheeled and tracked mobile robots only.
5) In mobile robots, locomotion mechanisms enable it to move unbounded throughout its environment.

B- Choose the correct answer: **(5 Marks)**

1- The main problems in Wheeled Mobile Robots (WMR) design are ……..				
a- traction	b- maneuverability	c- stability	d-control	e- all of the above
2- Which one of the following are Conventional wheel that are used in mobile robots except……				
a- powered fixed	b- castor	c- powered steering	d-universal	e- a ,b, and c
3- The components of a mobile robot are……				
a- controller	b- control software	c- sensors	d-actuators	e- both a ,b / f- all of them,
4- ……..robot is totally under control of a driver with a joystick or other control device.				
a- A manually teleoperated	b- Guarded tele-op	c- Autonomously randomized robot		
d- Autonomously guided robot	e- Line-following Car	f- none of them		
5- Locomotion and manipulation share the same core issues such that …..				
a- Stability	b-Contact characteristics	c- Environmental type	d- both a and b	e- all of them.

Question No. (3): **[10 Marks]**

The 3-DOFs robot, shown in the Fig. 1, is to move from point (3, 5, 5) to point (3, -5, 5) along a straight line, divided into 5 sections. The inverse kinematic equations of the robot are also given below. **Find** the angles of the three joints for each intermediate point.

$$\theta_1 = \tan^{-1}(P_x/P_y)$$
$$\theta_3 = \cos^{-1}[((P_y/C_1)^2 + (P_z - 8)^2 - 162)/\,162]$$
$$\theta_2 = \cos^{-1}[(C_1(P_z - 8)(1 + C_3) + P_y S_3)/(18(1 + C_3)C_1)]$$

Question No. (4): **[10 Marks]**

For the 2-DOFs robot arm given in Fig. 3 ($n = 2$), find (using the data given in Table I):

a) The total kinetic and potential energies (K and P)
b) The Christoffel symbols (c_{ijk}) **for only** $k = 2$
c) The equation of motion **for only** $k = 2$

Table I Data for Q4

$K = \frac{1}{2}\dot{q}^T \sum_{i=1}^{n} [m_i J_{v_i}(q)^T J_{v_i}(q) + J_{\omega_i}(q)^T R_i^0(q) I_i R_i^0(q)^T J_{\omega_i}(q)]\,\dot{q} = \frac{1}{2}\dot{q}^T D(q)\dot{q}$			$q = \begin{bmatrix}\theta_1 \\ d_2\end{bmatrix}$
$\sum_{j=1}^{n} d_{kj}(q)\,\ddot{q}_j + \sum_{i=1}^{n}\sum_{j=1}^{n} c_{ijk}(q)\,\dot{q}_i\dot{q}_j + \varphi_k(q) = \tau_k$			$k = 1, \ldots, n$
$c_{ijk} = \frac{1}{2}\left\{\frac{\partial d_{kj}}{\partial q_i} + \frac{\partial d_{ki}}{\partial q_j} - \frac{\partial d_{ij}}{\partial q_k}\right\}$		$P = \sum_{i=1}^{n} g^T r_{c_i}^0 m_i$	$\varphi_k = \frac{\partial P}{\partial q_k}$
$I_i = \begin{bmatrix} I_{xx_i} & 0 & 0 \\ 0 & I_{yy_i} & 0 \\ 0 & 0 & I_{zz_i} \end{bmatrix}$ for $i = 1, 2$	$J_{v_1} = \begin{bmatrix}0 & 0\\ 0 & 0\\ 0 & 0\end{bmatrix}$	$J_{v_2} = \begin{bmatrix}(d_2 - e_2)c_1 & s_1\\ (d_2 - e_2)s_1 & -c_1\\ 0 & 0\end{bmatrix}$	$J_{\omega_1} = J_{\omega_2} = \begin{bmatrix}0 & 0\\ 0 & 0\\ 1 & 0\end{bmatrix}$
$R_1^0 = R_2^0 = \begin{bmatrix} c_1 & 0 & s_1 \\ s_1 & 0 & -c_1 \\ 0 & 1 & 0 \end{bmatrix}$	$g = \begin{bmatrix}0\\ 0\\ g\end{bmatrix}$	$r_{c_1}^0 = \begin{bmatrix}0\\ 0\\ e_1\end{bmatrix}$	$r_{c_2}^0 = \begin{bmatrix}(d_2 - e_2)s_1\\ -(d_2 - e_2)c_1\\ l_1\end{bmatrix}$

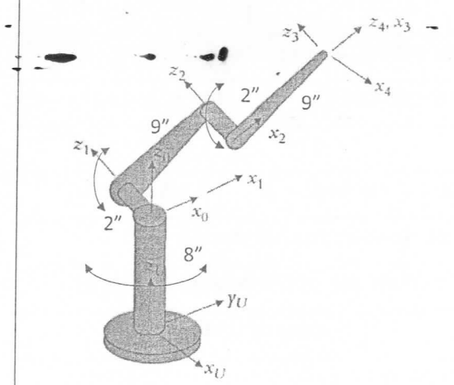


Fig. 1 3-DOFs Robot

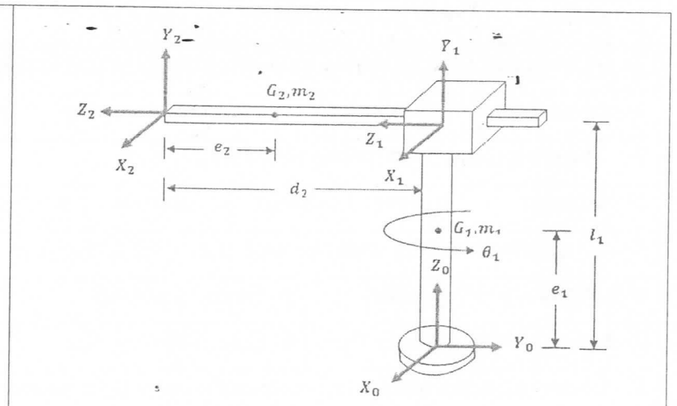


Fig. 2 2-DOFs Robot

---------- *End of Questions* ----------

With My Best Wishes

Dr. Omar Mehrez – Dr. Osama ElShazly

❑ لإجابة السؤال الثاني ارسم الجداول التالية في كراسة اجابتك ثم أجب عن السؤال.

Question No. (2-A) Answer

Question No.	True or False	Correction	
		False Word	Correct word
1			
2			
3			
4			
5			

Question No. (2-B) Answer

No.	Choice No.	Choice
1		
2		
3		
4		

Tanta University

Total Marks: 40 Marks

Faculty of Engineering

Course Title: Embedded Systems	**Course Code: EEC202**	**Level : 3**
Date: 28/5/2025 (لائحة جديدة)	**Allowed time: 2hrs**	**No of Pages (3)**

Question (1) : Answer the following question in the electronic answer form

1) Which of the following statements is correct?

a) RAM is non-volatile memory whereas ROM is a volatile memory

b) RAM is volatile memory whereas ROM is a non-volatile memory

c) Both RAM and ROM are volatile memories but in ROM data isn't lost when power is switched off

d) Both RAM and ROM are non-volatile memories but in ROM data isn't lost when power is switched off

2) The MULSU instruction works on R0 and R1 only.
a) True b) False

3) The range of byte-signed operands is
a) +127 to -128
b) +128 to -127
c) +128 to -128
d) +127 to -127

4) The CALL target address can be anywhere in the 4M word address space.
a) True b) False

5) The S flag is equal to the N flag, when .....
a) N flag = 1
b) V flag = 0
c) N flag = 0
d) V flag = 1

6) When using IN instruction, you can use the names of I/O registers instead of their addresses.
a) True b) False

7) When adding two signed numbers, ... is used to indicate whether the result is valid or not.
a) The S flag
b) The N flag
c) The V flag
d) The C flag

8) When adding the following numbers (-128 and -5), the values of N, S and V flags are
a) N=1 , S= 1 and V=0
b) N= 0, S= 0 and V=1
c) N= 0, S= 1 and V=1
d) N= 0, S= 0 and V=0

9) Is "MUL R2, 0x10" a valid AVR instruction?
a) True b) False

10) The subtraction instruction used for subtract an immediate value from a register pair and stores the result in the register pair is
a) SBI
b) SBIW
c) SBIB
d) SBIC

11) Storing of information on the stack is called a POP, while the loading of stack contents back into register is called a PUSH
a) True b) False

12) For inputting the data, if we put 1s into bits of PORTx register, the ..... are activated
a) PC
b) LEDS
c) switches
d) Pull up resistors

13) When adding the following numbers (+70 and +96), the values of N, S and V flags are
a) N=1, S= 1 and V=0
b) N= 0, S= 1 and V=1
c) N= 0, S= 0 and V=1
d) N= 1, S= 0 and V=1

14) Microcontrollers are normally less expensive than microprocessors
a) True b) False

15) All RAM, ROM, and EEPROM are in bits
a) True b) False

16) The vast majority of AVR registers are 32-bit registers
a) True b) False

17) The..... is 2-byte instruction. When the instruction executes the PC is loaded with the contents of Z register.
a) CALL
b) RCAL
c) ICAL
d) JMP

18) LDI instruction can load values into registers from 1 to 15
a) True b) False

19) EEPROM memory loses its data when power is off whereas SRAM does not
a) True b) False

20) The control buses are used to
a) provide read or write signals to the device
b) get data from the device or to send data to it
c) find any connected device
d) all of the above

21) Is "SBI R2, 0x10" a valid AVR instruction?
a) True b) False

22) Address assigned to any device must be unique
a) True b) False

23) In contrast to GPRs, the SFRs don't have any specific function, and are used for storing general data.
a) True b) False

24) The SBI, CBI, SBIC and SBIS instructions can be used for all the I/O registers.
a) True b) False

25) Which of the following is suitable for high volume
a) Flash memory
b) EPROM
c) Mask ROM
d) EEPROM

26) A single ROM is used to design a combinational circuit described by a truth table. What is the number of address lines in the ROM?
a) Number of input variables in the truth table
b) Number of output variables in the truth table
c) Number of input plus output variables in
d) Number of lines in the truth table

the truth table

27) Storage capacity in computers is bites. But, storage capacity of IC chip in bytes
a) True b) False

28) LDS instruction is a 2-bytes instruction, while IN is 4-bytes, so LDS is faster than IN.
a) True b) False

Question (2)

a) What is the function of Pull-up resistor? Sketch it.
b) Write the following programs
   i. Create a square wave of 60% duty cycle on bit 3 of Port C
   ii. Get data present at the pin of port C and send it to port B indefinitely, after adding the value of 5 to it.
   iii. If we want to make the pull-up resistors of port C active.
   iv. Subtract two 16-bit numbers, 2762H - 1296H. Place the difference in R26 and R27 registers.
c) What does "OUT OCR0, R23" do?
d) What is wrong with "STS 0CR0, R23"? What does it do?
e) Compare between RISC and CISC architecture (put your answer in table).

Question (3)

a) What are the advantages in using the .EQU directive to define a constant value?
b) What is the function of the DDRx register?
c) What the CBI and SBIS instructions do?
d) Find the time delay for the delay subroutine shown below if the system has an AVR with frequency of 10 MHz.

```
        LDI     R20, 200
BACK:   LDI     R25, 100
        NOP
        NOP
        NOP
HERE    DEC     R25
        BRNE    HERE
        DEC     R20
        BRNE    BACK
```

With Best Wishes
Ass. Prof. Heba A. Elkhobby

Tanta University

Total Marks: 40 Marks

Faculty of Engineering

Course Title: Embedded Systems	Course Code: EEC202	Level : 3
Date: 28/5/2025 (لائحة قديمة)	Allowed time: 3hrs	No of Pages (4)

Question (1) : Answer the following question in the electronic answer form

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7) When adding two signed numbers, ... is used to indicate whether the result is valid or not.
a) The S flag b) The N flag
c) The V flag d) The C flag

8) When adding the following numbers (-128 and -5), the values of N, S and V flags are
a) N=1 , S= 1 and V=0 b) N= 0, S= 0 and V=1
c) N= 0, S= 1 and V=1 d) N= 0, S= 0 and V=0

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a) True b) False

20) The control buses are used to
a) provide read or write signals to the device b) get data from the device or to send data to it
c) find any connected device d) all of the above

21) Is "SBI R2, 0x10" a valid AVR instruction?
a) True b) False

22) Address assigned to any device must be unique
a) True b) False

23) In contrast to GPRs, the SFRs don't have any specific function, and are used for storing general data.
a) True b) False

24) The SBI, CBI, SBIC and SBIS instructions can be used for all the I/O registers.
a) True b) False

25) Which of the following is suitable for high volume
a) Flash memory b) EPROM
c) Mask ROM d) EEPROM

26) A single ROM is used to design a combinational circuit described by a truth table. What is the number of address lines in the ROM?
a) Number of input variables in the truth table b) Number of output variables in the truth table
c) Number of input plus output variables in d) Number of lines in the truth table

the truth table

27) Storage capacity in computers is bites. But, storage capacity of IC chip in bytes
a) True b) False

28) LDS instruction is a 2-bytes instruction, while IN is 4-bytes, so LDS is faster than IN.
a) True b) False

Question (2)

a) What is the function of Pull-up resistor? Sketch it.
b) Write the following programs
   i. Create a square wave of 60% duty cycle on bit 3 of Port C
   ii. Get data present at the pin of port C and send it to port B indefinitely, after adding the value of 5 to it.
   iii. If we want to make the pull-up resistors of port C active.
   iv. Subtract two 16-bit numbers, 2762H - 1296H. Place the difference in R26 and R27 registers.
c) What does "OUT OCR0, R23" do?
d) What is wrong with "STS 0CR0, R23"? What does it do?
e) Compare between RISC and CISC architecture (put your answer in table).

Question (3)

a) What are the advantages in using the .EQU directive to define a constant value?
b) What is the function of the DDRx register?
c) What the CBI and SBIS instructions do?
d) Find the time delay for the delay subroutine shown below if the system has an AVR with frequency of 10 MHz.

```
        LDI     R20, 200
BACK:   LDI     R25, 100
        NOP
        NOP
        NOP
HERE    DEC     R25
        BRNE    HERE
        DEC     R20
        BRNE    BACK
```

e) What does the LDS instruction do?
f) How is the IN instruction different from LDS?
g) What is the difference between ADD and ADC?
h) What is the difference between the N and S flags?
i) Which flags will be affected


```
LDI R20, 0x7F
LDI R21, 0x01
ADD R20, R21
```

With Best Wishes
Ass. Prof. Heba A. Elkhobby

Tanta University

Production Engineering and Mechanical Design Department

Final Exam – Second Term – Academic Year 2024/2025

Faculty of Engineering

Course Title: Introduction to Microelectromechanical Systems	**Course Code:** PDE 431	**Year:** Mechatronics Students
Date: 29 May 2025	**Allowed Time:** 3 Hrs.	**Total Marks:** 40

تعليمات: (١) الامتحان مكون من سؤالين في ثلاث صفحات – (٢) أجب عن جميع الأسئلة مع افتراض أي بيانات ناقصة – (٣) دعم إجابتك بالرسم كلما أمكن ذلك.

Question 1: [40 × 0.75 Marks = 30 Marks]

من نقطة رقم (١) الي نقطة رقم (٤٠)، اختر الإجابة الصحيحة (الأكثر دقة) وظلل اجابتك في ورقة التصحيح الالكتروني (المرفقة مع كراسة الإجابة) باستخدام القلم الجاف الأزرق.

1-	**Only MEMS technology can allow the upcoming widespread of IoT possible due to its …… .**						
A-	high production rate	B-	low production cost	C-	ease of use	D-	A and B
2-	**In photolithography, the minimum linewidth that can be printed on the photoresist depends on …… .**						
A-	wavelength of the light	B-	gap between the photomask and the wafer	C-	machine power	D-	A and B
3-	**…… PR becomes more soluble when exposed to light.**						
A-	Positive	B-	Negative	C-	Neutral	D-	Light-sensitive
4-	**A 1 µm thick Si layer can be thermally oxidized to produce …… µm thick SiO_2 layer.**						
A-	>1	B-	<1	C-	=1	D-	= 0.5
5-	**In the deposition by evaporation process, the problem of missed steps occurs because the evaporated atoms travel to the wafer in …… .**						
A-	low pressure	B-	high pressure	C-	low vacuum	D-	high vacuum
6-	**In the RF sputtering system, the sputter target is placed on the ……, while wafers are placed on the …… .**						
A-	cathode – diode	B-	diode – anode	C-	cathode – anode	D-	anode – cathode
7-	**In CVD, the deposition is conformal over all kinds of surface topography, because reactant gases are transported through …… .**						
A-	osmosis	B-	dialysis	C-	diffusion	D-	active transport
8-	**The first step in Atomic Layer Deposition (ALD) is pulsing …… over a substrate having a monolayer of OH.**						
A-	$(C_2H_5)_4Zn$	B-	$(C_2H_5)_2Zn$	C-	$(C_2H_5)_4Si$	D-	$(C_2H_5)_2Si$
9-	**Metals can be electroplated over a metal seed layer on a substrate, as electrical current carries metal ions from a metal …… to a(n) …… in an electrolyte.**						
A-	cathode – anode	B-	anode – cathode	C-	diode- anode	D-	cathode – diode
10-	**Soft …… is a technology that uses a soft elastomer to form a replica of photolithographically defined patterns.**						
A-	photography	B-	radiography	C-	lithography	D-	biography
11-	**The energy of direct bonding between silicon wafers can be …… by high-temperature treatment.**						
A-	increased	B-	decreased	C-	stabilized	D-	normalized
12-	**Anodic bonding can occur between a silicon wafer and a glass wafer that contains mobile …… ions.**						
A-	sodium	B-	potassium	C-	sodium and potassium	D-	sodium and/or potassium
13-	**Wafer bonding with metallic interlayer offers a …… seal with high bonding strength.**						
A-	covalent	B-	non-covalent	C-	hermetic	D-	non-hermetic

14-	**Glass frit bonding can tolerate some surface …… .**						
A-	hardness	B-	roughness	C-	stress	D-	strain
15-	**A(n) …… etchant etches silicon independent of the crystal plane.**						
A-	isotropic	B-	anisotropic	C-	sub-crystal	D-	Miller
16-	**Wet etching in MEMS processing is typically done …… 100 °C.**						
A-	above	B-	below	C-	at	D-	far above
17-	**There are basically …… etching modes with plasma.**						
A-	two	B-	three	C-	four	D-	five
18-	**In Reactive Ion Etching (RIE), the etching is done by …… effect(s).**						
A-	physical	B-	chemical	C-	aerodynamic	D-	A and B
19-	**In the electrostatically actuated comb drive, the vertical force components are …… .**						
A-	added	B-	multiplied	C-	energized	D-	cancelled
20-	**In the comb drive, the electrostatic force in the x direction depends on the following parameters except …… .**						
A-	air permittivity	B-	applied voltage	C-	air gap	D-	overlap length
21-	**The …… of the electrostatic micromotor allows the rotor to rotate but not to translate.**						
A-	finger	B-	hub	C-	shoulder	D-	under-cut
22-	**Typically, the "pull-in effect" in electrostatic actuation happens when the two plates, separated by an air gap, are drawn together by …… of the initial gap between the two plates.**						
A-	one-third	B-	one-fourth	C-	one-sixth	D-	half
23-	**In the mechanically tunable …… filter, the cutoff wavelength depends on the air-gap spacing between the permalloy plates.**						
A-	IR	B-	IRI	C-	IC	D-	ICI
24-	**One of the difficulties of scaling electromagnetic motors to the micron scale is fabricating …… on a chip.**						
A-	high-impedance terminals	B-	large-turn coils	C-	high-ohmic resistors	D-	large number of ICs
25-	**The piezoelectric bimorph produces …… displacement.**						
A-	axial	B-	bending	C-	torsional	D-	B and C
26-	**In the ultrasonic motors, the …… is the element carrying the waves.**						
A-	rotor	B-	stator	C-	pole	D-	impeller
27-	**In the chevron-type actuator, the lateral displacement of the shuttle depends on the …… between the anchors.**						
A-	resistance	B-	impedance	C-	capacitance	D-	voltage
28-	**The optical switching of DLP mirrors is used to store the information for the position of the yoke, either +……° or –……° .**						
A-	5, 5	B-	10, 10	C-	5, 10	D-	10, 5
29-	**In a Grating Light Valve, …… is deposited on top of the silicon nitride for an electrical connection and optical throughput.**						
A-	Aluminum	B-	Zinc	C-	Copper	D-	Tin
30-	**In a TMA mirror, the grayscale control is obtained by tilting the mirror at an angle from 0 to 6° and using a(n) …… filter.**						
A-	high-pass	B-	RC	C-	knife	D-	edge
31-	**There is a trade-off between the sensitivity of the accelerometer and its …… .**						
A-	frequency	B-	resolution	C-	hysteresis	D-	bandwidth
32-	**A silicon …… sensor is typically made by implanting dopants – to form resistors – on a bulk-micromachined silicon diaphragm.**						
A-	light	B-	torque	C-	temperature	D-	pressure
33-	**Without the …… , the diaphragm of the capacitive microphone will be damped too much.**						
A-	implants	B-	capacitors	C-	holes	D-	pre-strain
34-	**…… valves are opened by default and closed by the energy from fluid.**						
A-	Passive	B-	Active	C-	Reactive	D-	Pulsive

35-	**MEMS microphones could withstand 250°C, a relatively high temperature needed for automated …… .**						
A-	charging	B-	soldering	C-	pre-straining	D-	B and C
36-	**As advantage(s) of the piezoelectric MEMS microphone, …… .**						
A-	needless of DC bias voltage	B-	good linearity	C-	simple fabrication	D-	A, B, and C
37-	**…… micropumps are inherently prone to mixing downstream fluid with upstream.**						
A-	Valved	B-	Valveless	C-	Pulsive	D-	Repulsive
38-	**Diaphragm bending that can produce the fluid motion obtained with …… actuation consumes the largest power and responds slowest to electrical input.**						
A-	electrostatic	B-	electrothermal	C-	piezoelectric	D-	piezoresistive
39-	**The response of the simplest accelerometer versus frequency is uniform up to about the …… frequency.**						
A-	linear	B-	exponential	C-	cutoff	D-	resonant
40-	**Among many renewable energy sources, …… is (are) particularly attractive due to its (their) ubiquity.**						
A-	winds	B-	sunlight	C-	vibrations	D-	sea waves

Question 2: [5 × 2 Marks = 10 Marks]

Use only *sketching* to show:

1- The steps of the Damascene process.
2- The ultrasonic motor.
3- The electrostatic scratch drive actuator (SDA).
4- The electrostatically actuated optical reflective switch.
5- The operational principle of quake valve.

انتهت الأسئلة

مع أطيب التمنيات بالتوفيق والنجاح .... د.م/ أحمد حوام واللجنة

Tanta University

Department: Mechatronics Program.
Total Marks: 40 Marks

Faculty of Engineering

Course Title: **Image Processing**	Course Code: EEC404	Level: **5th**
Date: 21.JUN. 2025	Allowed time: **3:00 hrs**	No. of Pages: **(3)**

(Question 1) (Total: 20 Marks)

1) In spatial domain, which of the following operation is done on the pixels in sharpening the image?
a)Integration b)Average c)Median d) Differentiation

2) In an application averaging mask is applied to input images to reduce noise and then a Laplacian mask is applied to enhance small details, if the order of these operations are reversed then the results of the two sequences are ……
a) different due to nonlinearity of Laplacian b) different due to nonlinearity of averaging
c) different due to nonlinearity of both operations d) the same due to linearity of both operations

3) The power-law transformation is given as: $s = cr^{\gamma}$, c and γ are positive constants, and r is the gray-level of image before processing and s after processing. What happens if we increase the gamma value from 0.3 to 0.7?
a) The contrast increases and the detail increases b) The contrast decreases and the detail decreases
c) The contrast decreases and the detail increases d) The contrast increases and the detail decreases

4) In Histogram Matching or Specification, $z = G^{-1}[T(r)]$, r and z are gray level of input and output image and T & G are transformations, to confirm the single value and monotonous of G^{-1} what of the following is/are required?
a) G must be monotonic b) G must be strictly decreasing
c) G must be strictly monotonic d) all of the mentioned e) None of the mentioned

5) For a local enhancement using mean and variance, there is one condition: $m_{s(x,y)} \leq k_0 M_G$, where, M_G is global mean, k_0 a constant and $m_{s(x,y)}$ a measure of gray value as light or dark at point (x, y). Then, which fact is true for k_0?
a) It is a negative constant with values less than -1.0 b) It is an integer constant with values between -1.0 and 1.0
c) It is a positive constant with values less than 1.0 d) None of the mentioned

6) For a local enhancement using mean and variance, there is one condition: $\sigma_{s(x,y)} \leq k_2 D_G$, where, D_G is global standard deviation, k_2 a positive constant and $\sigma_{s(x,y)}$ a measure of contrast at point (x, y). Then, which fact is true for k_2 if its values is greater than 1.0?
a) Enhancement is being done on light areas b) Enhancement is being done on dark areas
c) Enhancement is being done independent of value of k_0 d) None of the mentioned

7) A filter is applied to an image whose response is independent of the direction of discontinuities in the image. The filter could be ……
a) Median filter b) Laplacian filter c) Gradient filter d) Sobel filters

8) A mask of size 3x3 is formed using Laplacian including diagonal neighbours that has central coefficient as 9. Then, what would be the central coefficient of same mask if it is made without diagonal neighbours?
a) 5 b) -5 c) 8 d) -8

9) The gradient is which of the following operator?
a) Linear operator b) Order-Statistic operator
c) Nonlinear operator d) None of the mentioned

10) A First derivative in image processing is implemented using which of the following given operator(s)?
a) Magnitude of Gradient vector b) The Laplacian
c) Phase of Gradient vector d) None of the mentioned

11) The type of interpolation where the intensity of the 16- neighbouring pixels contributes to obtain intensity of a new location is called……
a) bicubic interpolation b) quadratic interpolation
c) hexagonal interpolation d) bilinear interpolation

12) In washed out image, the components of histogram are concentrated on which side of the grey scale?
a) High b) Medium c) Low d) Evenly distributed

13) The absence of receptors is in the retinal area called……..
a) blind spot b) ciliary body c) Lens d) fovea

14)The transition between continuous values of the image function and its digital equivalent is called
a) Quantization b) Sampling c) Rasterization d) None of the Mentioned

15) Images quantized with insufficient brightness levels will lead to the occurrence of …..
a) Pixilation b) Blurring c) False Contours d) None of the Mentioned

16) The distance measures the path between the pixels based on an 8-connected neighbourhood, is called:
a) Euclidean distance b) City-Block distance
c) Chessboard distance d) None of these

17) The most familiar single sensor used for Image Acquisition is ……..
a) microdensitometer b) photodiode c) CCD d) none of the mentioned

18) The non-linear spatial filters whose response is based on ordering of the pixels contained is called ……..
a) box filter b) order-statistic filter c) gaussian filter d) smoothing filter

19) Response of the gradient to noise and fine detail is ……..…….. the Laplacian's.
a) equal to b) lower than c) greater than d) has no relation with

20) What is the next step in image processing after compression?
a) Wavelets b) Morphological processing c) Representation and description d) Segmentation

(Question 2) (Total: 20 Marks)

1) Given the following image f(x,y) shown as follows. Let the input and output gray levels are in the range of [0, 7]. Assume that the expected probabilities of gray levels in the output image are {0: 10%, 1: 15%, 2: 20%, 3: 20%, 4: 15%, 5: 10%, 6: 5%, 7: 5%}. Apply histogram specification on this image. **(5 Marks)**

$$\begin{bmatrix} 0 & 0 & 1 & 1 & 2 & 2 & 3 & 3 \\ 0 & 0 & 1 & 1 & 2 & 2 & 3 & 3 \\ 4 & 4 & 5 & 5 & 6 & 6 & 7 & 7 \\ 4 & 4 & 5 & 5 & 6 & 6 & 7 & 7 \\ 0 & 0 & 1 & 1 & 2 & 2 & 3 & 3 \\ 0 & 0 & 1 & 1 & 2 & 2 & 3 & 3 \\ 4 & 4 & 5 & 5 & 6 & 6 & 7 & 7 \\ 4 & 4 & 5 & 5 & 6 & 6 & 7 & 7 \end{bmatrix}$$

2) Given an image segment shown below, find the intensity value of the circled pixel, **(5 Marks)**

124	48	44	37	140
126	40	31	45	145
131	30	25	52	150
142	42	60	78	163
149	56	38	162	166

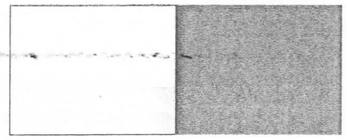
1) After applying a 3x3 median filter.

2) After applying the wighted averaging filter.

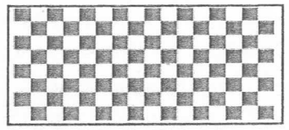
3)The two 256-gray levels images shown in the figure below have the same size and border. Although they are quite different inside they have the same histogram. Suppose that each image is blurred with a 3x3 averaging mask):

1) Explain why the two images give have the same histogram. **(5 Marks)**

2) Would the histogram of the blurred images still be equal? Explain.



(1)



(2)

4) Consider the colored image flowers.png, write the appropriate python commands to read the image then: **(5 Marks)**

A) show the image and its histogram in a sub-plotted figure.
B) Resize the image into its double size.
C) Rotate the image with 30° clockwise.

Best wishes

Examiner: Prof.(Assoc.) Dr. Mahmoud Alshewimy & The committee

Course Title	Hydraulic/Pneumatic Systems Design	Academic Year 2024/2025 Spring Term Exam	**Course Code**	MPE331
Year/ Level	**3th Level**			
Date	**24-May- 2025**	No. of Pages (4)	**Allowed time**	**2 hrs**
			Total Assessment Marks: 40	
Remarks: NO REMARKS				

Please, answer the following questions (assume any missing data):-

Question One, (12 Marks):

a) Sketch the engineering symbol for each of the following hydraulic circuits components and mention its function in one sentence: i- (double acting cylinder-doble piston rod) ii- (limited-rotation actuators) iii- (pressure reducing valve) iv- (solenoid-actuated, tandem centre, spring-centre, 3-position, 4-way valve) v- (pressure compensated flow valve).

b) Sketch a complete hydraulic power system to control the speed of a bidirectional, constant torque hydraulic motor.

c) Mention and sketch four methods of hydraulic actuators mounting.

d) A rotary actuator has the following physical data: outer radius of rotor is 10 mm; outer radius of vane is 32 mm and width of vane is 20 mm. If the torque load is 85 N.m, what pressure must be developed to overcome the load?

Question Two, (8 Marks):

a) Sketch a complete hydraulic power system which uses a compound pressure relief valve to unload the pump at low pressure during periods between work cycles.

b) Sketch a complete hydraulic power system which uses two pilot check valves to lock a cylinder actuator

Question Three, (10 Marks):

a) What is the function of the servo-valve? Sketch a mechanical-type servo system showing how the output is fed to modify the input.

b) What is the hydrostatic transmission system? Mention three applications of this system and identify its advantages.

c) A pressure relief valve (PRV) contains a poppet with a 4.20-cm² area on which system pressure acts. During assembly a spring with a spring constant of 3200 N/cm is installed in the valve to hold the poppet against its seat. The adjustment mechanism is then set so that the spring is initially compressed 0.50 cm from its free-length condition. In order to pass full pump flow through the valve at the PRV pressure setting, the poppet must move 0.30 cm from its fully closed position. Determine the

- **i) Cracking pressure**
- **ii) Full pump flow pressure (PRV pressure setting)**
- **iii) What should be the initial compression of the spring in the PRV if the full pump flow pressure is to be 40% greater than the cracking pressure?**

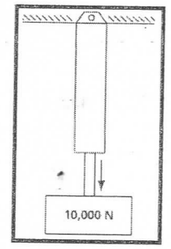
Question Four, (10 Marks):

a) For a hydraulic power system which is driven by an electric motor (i, e) to actuate a hydraulic cylinder against a load F and moves with a velocity V. Sketch a diagram which shows the power transmission and transformation chain to drive the load. Indicate the causality relationship with the related formulae.

Mechatronics Engineering Program / Mechanical Power Engineering Department

Tanta University — Faculty of Engineering

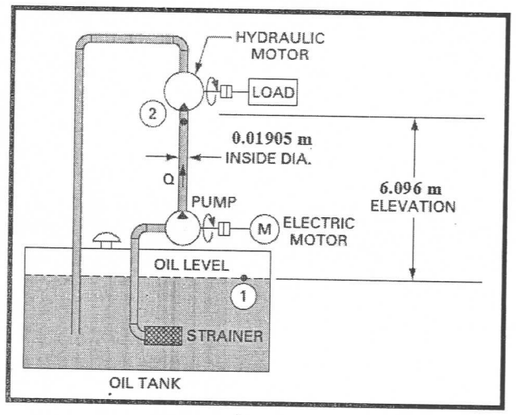
b) A 10,000 N weight is to be lowered by a vertical cylinder, as shown in Figure. The cylinder has a 75-mm-diameter piston and a 50-mm-diameter rod. The weight is to decelerate from 100 m/min to a stop in 0.5 s. Determine the required pressure in the rod end of the cylinder during the deceleration motion.



c) For the hydraulic system in the Figure, the following data are given:

1. **The pump is adding 2.984 kW to the fluid.**
2. **Pump flow is 0.00158 m³/s.**
3. **All pipes has 0.01905 m inside diameter.**
4. **The specific gravity of the oil is 0.9.**
5. **The oil tank is vented to the atmosphere.**
6. **The elevation difference between stations 1 and 2 is 6.096 m.**
7. **The pressure at station 1 in the hydraulic tank is atmospheric**
8. **The head loss H_L between stations 1 and 2 is 12.19 m of oil.**

Find the pressure available at the inlet to the hydraulic motor (station 2).



End of questions

Good Luck

EXAMINERS	*Prof. Dr. Ayman Bakry*	

Course Title	Hydraulic/Pneumatic Systems Design	Academic Year 2024/2025 Spring Term Exam	**Course Code**	MEP331
Year/ Level	**4th Level**			
Date	**24-May- 2025**	No. of Pages (4)	**Allowed time**	**3 hrs**
			Total Assessment Marks: 40	
Remarks: NO REMARKS				

Please, answer the following questions (assume any missing data):-

Question One, (10 Marks):

a) Sketch the engineering symbol for each of the following hydraulic circuits components and mention its function in one sentence: i- (double acting cylinder-single piston rod) ii- (limited-rotation actuators) iii- (pressure relief valve) iv- (hand-actuated, open centre, spring-centre, 3-position, 4-way valve) v- (Non-pressure compensated flow valve).

b) What is the function of the stop tube in hydraulic actuators.

c) Sketch a complete hydraulic circuit used for the automatic continuous reciprocation of a hydraulic cylinder. Please, write the names of each component in the sketch.

d) A rotary actuator has the following physical data: outer radius of rotor is 10 mm; outer radius of vane is 32 mm and width of vane is 20 mm. If the torque load is 85 N. m, what pressure must be developed to overcome the load?

Question Two, (10 Marks):

a) Sketch a complete hydraulic power system which uses a compound pressure relief valve to unload the pump at low pressure during periods between work cycles.

b) Sketch a complete hydraulic power system which uses an unloading pressure valve to unload a single pump.

c) Sketch a complete hydraulic power system which uses an unloading pressure valve to unload a large, high flowrate/low-pressure pump of a double pump hydraulic system for a stamping machine.

d) Sketch a complete hydraulic power system which uses two pilot check valves to lock a cylinder actuator

Question Three, (10 Marks):

a) What is the hydrostatic transmission system? Mention three applications of this system and identify its advantages.

b) A hydrostatic transmission, operating at 105 bars pressure, has the following characteristics:

Pump	*Motor*
$V_D = 100\ cm^3$	$V_D = ?$
$\eta_v = 85\%$	$\eta_v = 94\%$
$\eta_m = 90\%$	$\eta_m = 92\%$
$N = 1000$ rpm	$N = 600$ rpm

Find: a) Displacement of the motor b) Motor output torque

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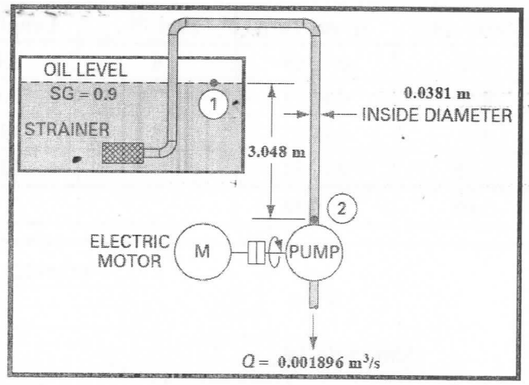
Power Engineering Department
Tanta University — Faculty of Engineering

c) The oil tank for the hydraulic system shown in Figure is air-pressurized at 68.97 kPa gage. The inlet line to the pump is 3.048 m below the oil level and the pipe has a 0.0381 m inside diameter. The pump-flow rate is 0.001896 m^3/s. Find the pressure at station 2 if:

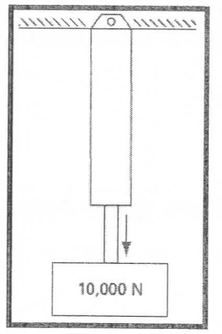
i) There is no head loss between stations 1 and 2.
ii) There is a 7.622 m head loss between stations 1 and 2



Question Four, (10 Marks):

a) For a hydraulic power system which is driven by an electric motor (i, e) to actuate a hydraulic cylinder against a load F and moves with a velocity V. Sketch a diagram which shows the power transmission and transformation chain to drive the load. Indicate the causality relationship with the related formulae.

b) A 10,000 N weight is to be lowered by a vertical cylinder, as shown in Figure. The cylinder has a 75-mm-diameter piston and a 50-mm-diameter rod. The weight is to decelerate from 100 m/min to a stop in 0.5 s. Determine the required pressure in the rod end of the cylinder during the deceleration motion.

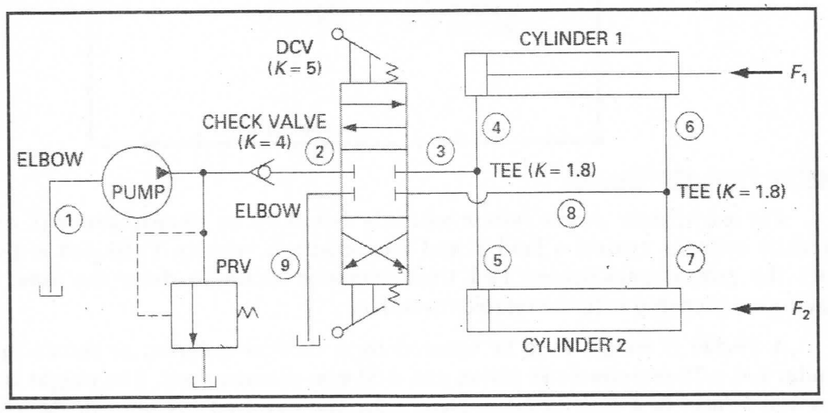


c) For the fluid power system shown in the following Figure, determine the external load (F_1 and F_2) that each hydraulic cylinder can sustain while moving in the extending direction. Take frictional pressure losses into account. The pump produces a pressure increase of 69 bars from the inlet port to the discharge port and a flow rate of 0.00252m^3/s. The following data are applicable:

Kinematic viscosity of oil = 0.000093 m^2/s
Specific weight of oil = 7840 N/m^3
Cylinder piston diameter = 0.203 m
Cylinder rod diameter = 0.102 m
All elbows are 90° with *K* factor = 0.75

Pipe lengths and inside diameters are given as follows:

Pipe No.	Length (m)	Diam. (m)	Pipe No.	Length (m)	Diam. (m)
1	1.83	0.0508	6	3.05	0.0254
2	9.15	0.0317	7	3.05	0.0254
3	6.1	0.0317	8	12.2	0.0317
4	3.05	0.0254	9	12.2	0.0317
5	3.05	0.0254			



Also, determine the heat-generation rate due to frictional pressure losses and calculate the retracting and extending speeds of both cylinders. Assume that the actual cylinder loads are equal and are less than the loads that can be sustained during motion.

End of questions *Good Luck*

EXAMINERS	*Prof. Dr. Ayman Bakry*	

Tanta University

Mechatronics Engineering Program

Total marks: 40 Marks

Faculty of Engineering

Course Title: Advanced Mechatronics Systems
Course Code: MEP 451
Year: 5th Level Mechatronics Engineering

Final exam

Date: 31 / 5 / 2025
Allowed time: 3 Hours
No. of pages: 2 pages

Solve the following questions

Question 1) **(10 Marks)**

A) What is the difference between Inductive and Capacitive Proximity?
B) Explain the principal operation for magnetic encoder?
C) What is a Tacho-generator? Explain its principal operation?
D) What are the parameters varying the capacitance value of the variable capacitor?
E) What is the principal operation for load cell?

Question 2) **(7 Marks)**

A) Explain the types of the Timer?
B) What is the difference between Circuit breaker and Overload?

C) A linear variable differential transformer has a stroke length of ±150mm and produces a resolution of 40mV/mm when moved.

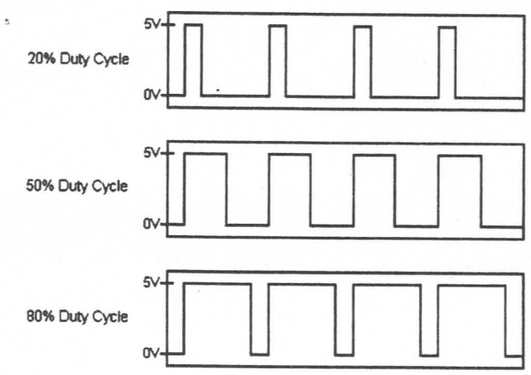
Determine:

I. The LVDT's maximum output voltage.
II. The output voltage when the core is moved 120mm from its null position.
III. The core position from center when the output voltage is 3.75 volts.
IV. The change in output voltage when the core is moved from +80mm to -80mm displacement.

Question 3) **(8 Marks)**

A) Arduino can give a signal between 0 and 5V. The shown figure expresses the duty cycle (expressed as a percentage) describes the width of the pulse within that frequency window. The value is from 0 up to 255.

I. Define the PWM
II. Write the Arduino code for getting the reading (output pin is pin No. 9)
III. What is the value of analogWrite(pin, value) for each duty cycle?
IV. What are the different options of reading real analog input?

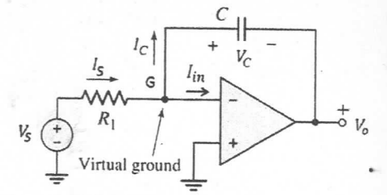


B) Solve the following questions:

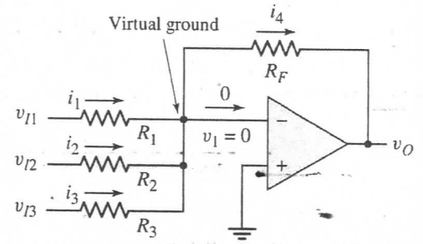
I. What is the main purpose of using Data acquisition?
II. What is EMG and EOG sensors?
III. Why should these sensors be used with filters?
IV. Explain the used filters

Question 4) **(7 Marks)**

A) The integrator circuit as shown in figure has an initial voltage V_x=−1.4 V across the capacitor at time t=0. Step input voltage V_S=−2V is applied at time t=0. **Determine the RC time constant necessary** such that the output voltage reaches +10.2V at time t= 5.0 ms.



B) Design a summing amplifier as shown in figure to produce a specific output signal, such that v_o = **1.25 – 2.5 cos ωt** volt. Assume the input signals are v_{I1} = **-1.0 V**, v_{I2} = **0.5 cos ωt** volt. Assume the feedback resistance R_F = 10 kΩ



C) A stepper motor has a step angle = 3.6°.

I. How many pulses are required for the motor to rotate through ten complete revolutions?
II. II) What pulse frequency is required for the motor to rotate at a speed of 100 rpm (rev/min)?

Question 5) **(8 Marks)**

A) What is the problem of using chopping circuits to control Brushed DC? Then describe how to control DC motor using H-bridge?
B) What is the main components of servo motors, and how to control
C) Describe Variable reluctance stepper motor

D) A 220 V series motor is taking a current of 40 A. The resistance of the series field is 0.25 Ω. Calculate the following:

I. Voltage at the brushes
II. Back emf
III. Power wasted in armature
IV. Power wasted in field

Tanta University Faculty of Engineering Mechatronics Program			Final Exam Second-Term-2nd Level Academic Year: 2024/2025
Department: Mechatronics	**Couse Code:** MPE 252	**Course:** Mechatronics Systems لائحة جديدة	
Examiner: Dr. Osama Elshazly	**Date:** 31/5/2025	**Time:** 2 Hours	**Total Marks:** 40

Answer the Following Questions: **5 Questions in 3 Pages**

Question No. (1): [7.5 Marks-0.5 mark for each point]

➢ **True or False and correct the false ones?**

1. Low initial cost is one of the advantages of Mechatronics systems.
2. Trained workers with only one engineering field background is essential in Mechatronics systems.
3. Mechatronics systems do not include sensors and actuators elements.
4. In a measurement system, the transducer performs filtering, amplification, or other signal conditioning on the transducer output.
5. In mechatronic systems, signal processing facilitates the higher-level monitoring of the manufacturing operation.
6. Sensor's accuracy is the measuring instrument's property to respond to the measured quantity changes.
7. LVDT sensor has three primary and four secondary coils with same number of turns for primary ones.
8. Absolute encoder must have an external processing of signals to obtain the angular position of a motor.
9. The belt's slack side has a larger tension value than the other side.
10. Cam and follower mechanism can transform a translational motion into a rotary motion.
11. Higher kinematic pair mean the two links have a surface of area contact between them
12. Crossed-belt drive is used when driven and driving pulleys are to be rotated in the same direction.
13. Fluid link is a link which is partially deformed in a manner that affects the transmission of motion.
14. If a link is in a pure translation, the orientation of the link will be variable
15. Radial follower is one when the motion of it is along an axis away from the axis of the cam center.

Question No. (2): [10 Marks- 1 mark for each point]

➢ **Choose the correct answer:**

1- A good example of manufacturing applications of mechatronics system is .....

a- Automobile b- high speed train c- Segway robot d- CNC machines e- all of the above

2- The sensor's ..... measures the difference between the measured value and actual value.

a- repeatability b- sensitivity c- precision d- accuracy

3- A ..... sensor can be found in Laptop track Pads.

a- capacitive b- inductive c- both a and b d- none of the above

4- LVDT can be considered as ..... sensor.

a- capacitive b- inductive c- resistive d- none of the above

5- The gauge factor of a strain gauge is .....

a- $\frac{\Delta R/R}{\Delta L/L}$ b- $\frac{\Delta L/L}{\Delta R/R}$ c- $\frac{\Delta R/R}{\Delta D/D}$ d- $\frac{\Delta R/R}{\Delta \rho/\rho}$

6- In the Encoder, ...is used to filter signal into square wave used by microcontroller.

a-Mask b- LED c- Photodetector d- Electronic board

7- The.....encoder keeps the correct position value in case of loss of power.

a- single channel incremental b- Dual channel incremental c- absolute d- none of the above

8- The heart of any machine that is used to transfer motion from power source to an output is called.....

a- kinematics b- dynamics c- both a and b d- none of the above

9- .....involves determination of position, velocity, and acceleration of a mechanism

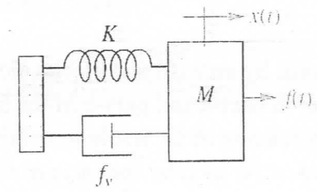
a- Kinematics b- Dynamics c- Both a and b d- None of the above

10- If a link is in a complex motion, the orientation and the translation of the link will be .....

a- constant b- variable c- Both a and b d- None of the above

Question No. (3): [5 Marks]

➢ Find the transfer function, $G(s) = X(s)/F(s)$, for the mechanical system shown in the following Figure:



Question No. (4): [7.5 Marks]

❖ Determine the **speeds** and **directions** of rotation of all the gear wheels in the gear train illustrated in Figure-1 given that **gear wheel 1** rotates at 1200 rpm, clockwise. The numbers of teeth on each gear wheel are given in Table-1 shown below. Tabulate your results. (اكتب إجابتك في جدول)

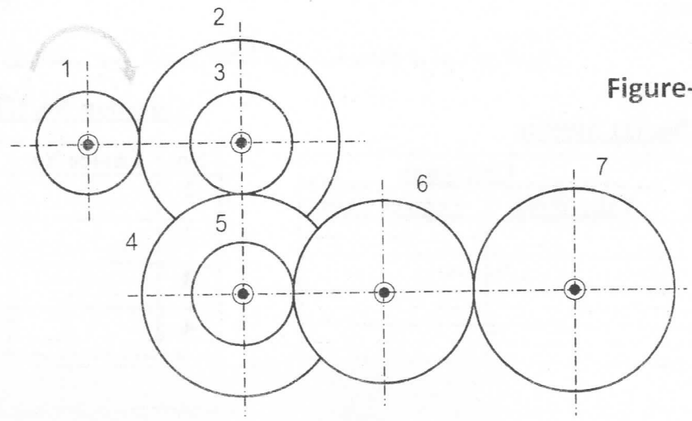


Figure-1

Gear Wheel	Number of Teeth	Gear Wheel	Number of Teeth
1	22	5	26
2	40	6	42
3	24	7	44
4	44		

Table-1

Question No. (5): **[10 Marks]**

A. Figure-2 shows the two types of the optical encoder used for position measurements:

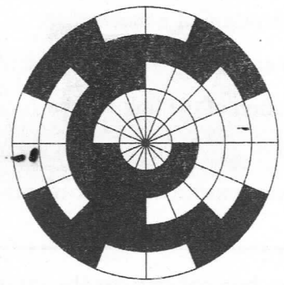


Figure – 2.a

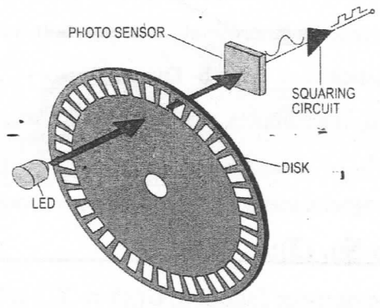


Figure – 2.b

Consider that **white color slot** is represented by **zero** (0) and **black color slot** is represented by (1).

1. What is the type of the encoder in **part-a** and **part-b** of the figure?
2. Write the equation used for calculation of the resolution of the two encoders?
3. How many tracks and bits used in the encoder shown in **part-a**?
4. Which type of codes is used in the encoder shown in **part-a**? Why?
5. Write down the table of the **code** used **with the description of angles**?

End of Questions

With My Best Wishes **Dr. Osama Elshazly**

❑ لإجابة السؤال الأول والثاني ارسم الجداول التالية في كراسة اجابتك ثم أجب عن السؤال.

Question No. (1) Answer

Question No.	True or False	Correction	
		False Word	Correct word
1			
2			
3			
4			

Question No. (2) Answer

No.	Choice No.	Choice
1		
2		
3		
4		

Tanta University **Faculty of Engineering** **Mechatronics Program**			**Final Exam** **Second-Term-2nd Level** **Academic Year: 2024/2025**
Department: Mechatronics	**Couse Code:** MEP 251	**Course:** Mechatronics Systems لائحة قديمة	
Examiner: Dr. Osama Elshazly	**Date:** 31/5/2025	**Time:** 3 Hours	**Total Marks:** 40

Answer the Following Questions: **5 Questions in 4 Pages**

Question No. (1): **[5 Marks-**0.25 mark for each point]

➢ **True or False and correct the false ones?**

1. Low initial cost is one of the advantages of Mechatronics systems.
2. Trained workers with only one engineering field background is essential in Mechatronics systems.
3. Mechatronics systems do not include sensors and actuators elements.
4. In a measurement system, the transducer performs filtering, amplification, or other signal conditioning on the transducer output.
5. In mechatronic systems, signal processing facilitates the higher-level monitoring of the manufacturing operation.
6. Sensor's accuracy is the measuring instrument's property to respond to the measured quantity changes.
7. LVDT sensor has three primary and four secondary coils with same number of turns for primary ones.
8. A dummy gauge can be used with the strain gauge in Wheatstone bridge to remove the pressure effect.
9. Absolute encoder must have an external processing of signals to obtain the angular position of a motor.
10. Stress is the deformation or change in shape/size of a material due to applied force.
11. Absolute encoder must have an external processing of signals to obtain the angular position of a motor.
12. The belt's slack side has a larger tension value than the other side.
13. In mechanism's kinematics analysis, the required maximum force of a mechanism must be determined.
14. Cam and follower mechanism can transform a translational motion into a rotary motion.
15. Higher kinematic pair mean the two links have a surface of area contact between them
16. Crossed-belt drive is used when driven and driving pulleys are to be rotated in the same direction.
17. Fluid link is a link which is partially deformed in a manner that affects the transmission of motion.
18. Revolute joint allows pure translation between the two links that it connects.
19. If a link is in a pure translation, the orientation of the link will be variable
20. Radial follower is one when the motion of it is along an axis away from the axis of the cam center.

Question No. (2): **[15 Marks-** 1 mark for each point]

➢ **Choose the correct answer:**

1- A good example of manufacturing applications of mechatronics system is ……

a- Automobile b- high speed train c- Segway robot d- CNC machines e- all of the above

2- The sensor's …….. measures the difference between the measured value and actual value.

a- repeatability b- sensitivity c- precision d- accuracy

3- A …….. sensor can be found in Laptop track Pads.

a- capacitive b- inductive c- both a and b d- none of the above

4- LVDT can be considered as …….. sensor.

a- capacitive b- inductive c- resistive d- none of the above

5- The gauge factor of a strain gauge is ……..

a- $\frac{\Delta R/R}{\Delta L/L}$ b- $\frac{\Delta L/L}{\Delta R/R}$ c- $\frac{\Delta R/R}{\Delta D/D}$ d- $\frac{\Delta R/R}{\Delta \rho/\rho}$

6- In the Encoder, ……...is used to filter signal into square wave used by microcontroller.

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7- The……encoder keeps the correct position value in case of loss of power.

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8- The heart of any machine that is used to transfer motion from power source to an output is called…….

a- kinematics b- dynamics c- both a and b d- none of the above

9- ……involves determination of position, velocity, and acceleration of a mechanism

a- Kinematics b- Dynamics c- Both a and b d- None of the above

10- If a link is in a complex motion, the orientation and the translation of the link will be ……

a- constant b- variable c- Both a and b d- None of the above

11- Links can be classified depending upon their type of connections into……..

a- binary b- ternary c- quaternary d- none of the above

12- A motor gear has 60 teeth and rotates at 100 rev/min. The driven gear has 30 teeth is connected through a 50 teeth gear to the driver to have the same direction of the driver. The driven rotational speed will be……..of the driver speed.

a- twice b- half c- equal d- none of the above

13- In …… gear train, the axis of the first and the last gears are co-axial and used clocks.

a- simple b- compound c- reverted d- planetary

14- To transfer power between two rotating shafts with distance between them equal to 2 meters, the …….. belt is more desirable.

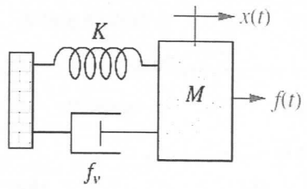
a- Flat b- V-shape c- circular d- timing

15- The ……. belt is mostly used in where a moderate amount of power is to be transmitted from one pulley to another.

a- Flat b- V-shape c- circular d- timing

Question No. (3): [5 Marks]

➢ Find the transfer function, $G(s) = X(s)/\mathrm{F}(s)$, for the mechanical system shown in the following Figure:



Question No. (4): [5 Marks]

❖ Determine the **speeds** and **directions** of rotation of all the gear wheels in the gear train illustrated in Figure-1 given that **gear wheel 1** rotates at 1200 rpm, clockwise. The numbers of teeth on each gear wheel are given in Table-1 shown below. Tabulate your results. (اكتب إجابتك في جدول)

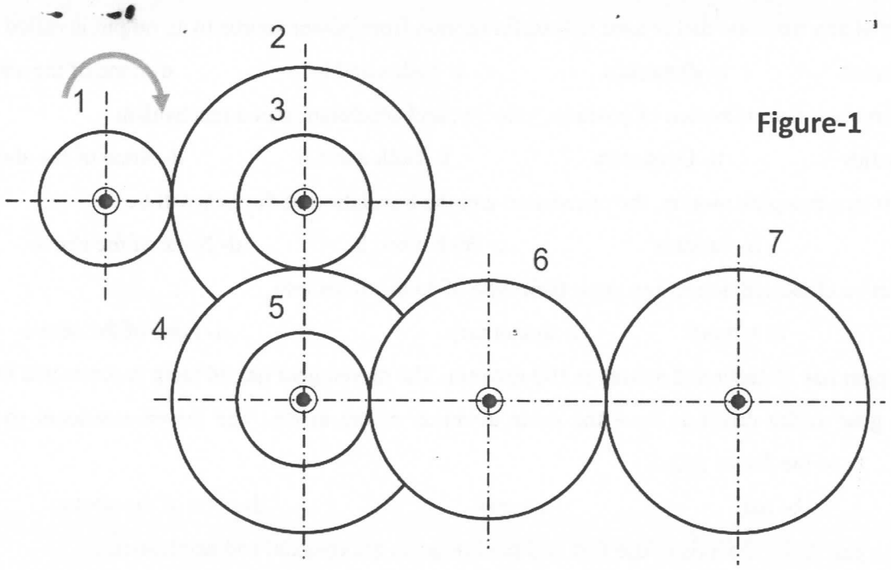


Figure-1

Gear Wheel	Number of Teeth	Gear Wheel	Number of Teeth
1	22	5	26
2	40	6	42
3	24	7	44
4	44		

Table-1

Question No. (5): [10 Marks]

A. A strain gauge is bonded to a beam of 200 mm long and having a cross-sectional area of 10 cm^2. Young's modulus for steel is 500 GPa. The strain gauge has an unstrained resistance of 480 Ω and a GF of 4. When a load is applied, the resistance of gauge changes by 0.02Ω.

➢ Find the change in length of the steel beam and the amount of force applied to the beam. **(3 Marks)**

B. Figure-2 shows the two types of the optical encoder used for position measurements: **(7 Marks)**

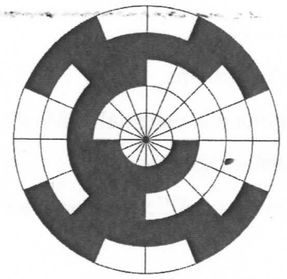


Figure – 2.a

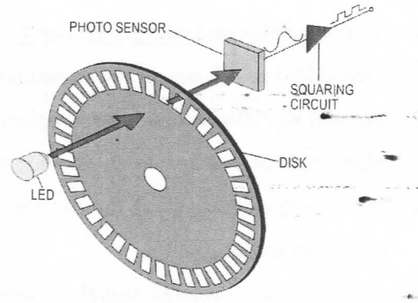


Figure – 2.b

Consider that **white color slot** is represented by **zero** (0) and **black color slot** is represented by (1).

1. What is the type of the encoder in **part-a** and **part-b** of the figure?
2. Write the equation used for calculation of the resolution of the two encoders?
3. How many tracks and bits used in the encoder shown in **part-a**?
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End of Questions

With My Best Wishes

Dr. Osama Elshazly

❑ لإجابة السؤال الأول والثاني ارسم الجداول التالية في كراسة اجابتك ثم أجب عن السؤال.

Question No. (1) Answer

Question No.	True or False	Correction	
		False Word	Correct word
1			
2			
3			
4			

Question No. (2) Answer

No.	Choice No.	Choice
1		
2		
3		
4		

Course Title	Heat Transfer	Academic Year 2024/2025 Second Semester Final Exam	Course Code	MEP404
Year/ Level	All levels			
Date	28-June-2025	No. of Pages (3)	Allowed time	3 hrs
			Total Assessment Marks: 40	
Remarks: Notes for Students: Neat and clear answers will be appreciated.				

Question Number (1)

(07 Points)

a) Draw the temperature distribution and heat flow lines along two solid plates pressed against each other for the case of perfect and imperfect contact and mention all factors that influence the value of thermal contact resistance. **(03 points)**

b) An aluminum pan as shown in **Fig.01** whose thermal conductivity is 237 W/m.K has a flat bottom with diameter 15 cm and thickness 0.4 cm. Heat is transferred steadily to boiling water in the pan through its bottom at a rate of 1400 W. If the inner surface of the bottom of the pan is at 105 °C, determine the temperature of the outer surface of the bottom of the pan. **(04 points)**

Question Number (2)

(08 Points)

a) Draw a schematic diagram and the corresponding thermal resistance network for heat transfer through a two-layer plane wall subjected to convection on both sides and write down the total resistance equation. **(02 points)**

b) By using the analogy between thermal and electrical resistance concepts, deduce the conduction resistance of the wall and the convection resistance of the surface. **(02 points)**

c) Consider a steam pipe of length L = 20 m, inner radius r_1 = 6 cm, outer radius r_2 = 8cm, and thermal conductivity k = 20 W/m•K, as shown in **Fig.02**. The inner and outer surfaces of the pipe are maintained at average temperatures of T_1 = 150°C and T_2 = 60°C, respectively. Obtain a general relation for the temperature distribution inside the pipe under steady conditions and determine the rate of heat loss from the steam through the pipe. **(04 points)**

Question Number (3)

(08 Points)

a) Applying the energy balance on a thin element of thickness Δx from a large plane wall (see **Fig.03**) during a small-time interval Δt to obtain the one-dimensional transient heat conduction equation in a plane wall and reduce this equation under three specified conditions. **(04 points)**

b) A composite wall is constructed as schematically shown in the **Fig.04** The thermal conductivities of the used materials are: k_A = 150 W/m.°C, k_B = 30 W/m.°C, k_C = 70 W/m.°C, and k_D = 50 W/m.°C. If the heat flow through the wall is assumed to be one-dimensional, determine the rate of heat transfer per unit area of the wall. The area perpendicular to the heat transfer direction for all layers of the composite wall are as follow: A_D = 1 m² and $A_A = A_D = 2A_B = 2A_C$. **(04 points)**

Question Number (4)

(10 Points)

a) Define the following parameters and explain their meaning (Nusselt Number - Velocity and thermal boundary layer thickness - Prandtl number – Reynolds number). **(02 points)**

b) Steam at a temperature of 250 °C flows through a steel pipe (AISI 10*10) of 60 mm inside diameter and 75 mm outside diameter. The convection coefficient between the steam and inner surface of the pipe is 500 W/m².°C, while that between the outer surface of the pipe and the surroundings is 25 W/m².°C, the pipe emissivity is 0.8 and the temperature of the air of surroundings is 20°C. What is heat loss per unit length of the pipe? (Take *kpipe*= 58 W/m.°C). **(04 points)**

c) stainless steel sphere (k = 16 W/m.°C) having a diameter of 4 cm is exposed to a convection environment at 20 °C, h = 15 W/m².°C heat is generated uniformly in the sphere at the rate of 1.0 MW/m³. Calculate the steady state temperature for the centre of the sphere. **(04 points)**

Question Number (5)

(08 Points)

a) How can the thermal contact resistance be minimized? Give practical example. **(02 points)**

b) Explain why fins are widely used in engineering applications. Give examples. **(02 points)**

b) An aluminium rod of 2.5 cm diameter and 15 cm long protrudes (ممتد وبارز) from a wall maintained at 260 °C. The rod is exposed to an environment at 16 °C. The convective heat transfer coefficient is 15 W/m².°C. If the thermal conductivity of aluminium is 200 W/m.°C, calculate the heat loss by the rod. Also, calculate the efficiency and effectiveness of the fin. **(04 points)**

End of questions.....

Best of Luck

Dr. Ahmed Mostafa Khaira

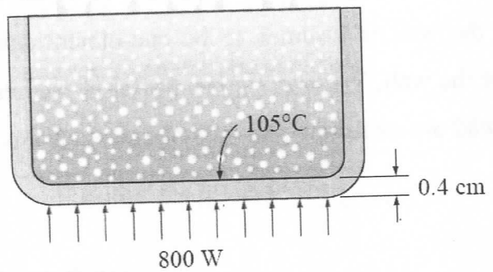


Fig.01 - Problem No.1 (b)

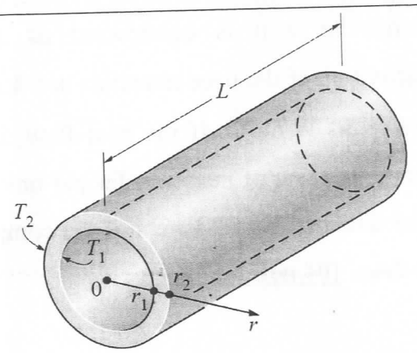


Fig.02 - Problem No.2 (c)

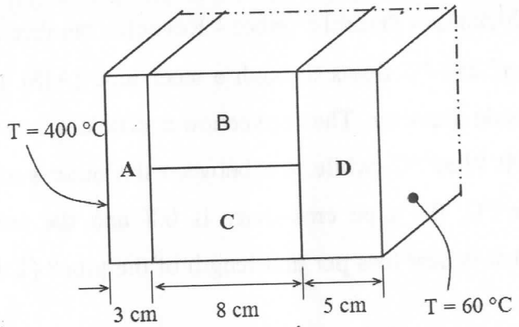
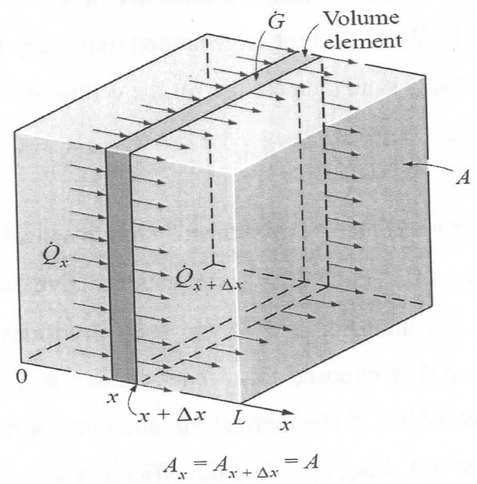


Fig.04 - Problem No. 3 (b)



$A_x = A_{x+\Delta x} = A$

Fig.03 - Problem No. 3 (a)

End of questions.....

Best of Luck *Dr. Ahmed Mostafa Khaira*