Q1) [10 marks]
Find the solution of the following system of linear equations by Grammer's rule:
\[-x + y + 2z = 2, 3x - y + z = 6, -x + 3y + z = 4.\]

Q2) [10 marks]
Find the points on the curve \( y = tanx, -\pi/2 < x < \pi/2 \), where the normal is parallel to the line \( y = -x/2 \). Then find the equations of these normal lines. Sketch the curve and the lines together.

Q3) [10 marks]
Sketch the region in the first quadrant bounded above by the curve \( y = coshx, \) below by the curve \( y = sinh x, \) on the left by y-axis and on the right by the line \( x = \ln 4, \) then find:
I) The area of this region
II) The volume of the solid generated by rotating this area about the x-axis.

Q4) [10 marks]
Sketch the circles: \( r = \sqrt{3} \cos \theta \) and \( r = \sin \theta \) in one graph, then find the area shared by these circles.

Q5) [10 marks]
Find the Maclaurin series of the functions: \( f(x) = e^x \) and \( g(x) = e^{-x} \)? then use these series to find the series of \( h(x) = sinh x.\)

Q6) [10 marks]
The derivative of \( f(x, y, z) \) at a point \( P \) is greatest in the direction of \( \nabla = i + j - k. \) In this direction the value of the derivative is \( 2\sqrt{3}. \) Find \( \nabla f \) at \( P \) and the derivative of \( f(x, y, z) \) at \( P \) in the direction of \( \nabla_2 = i + j. \)
Q1: Draw with scale (1:1) the "Simple Hook" shown in figure 1. (6 Marks)

Q2: Draw with scale (1:1) the front, top and right-side views of the body shown in figure 2. (10 Marks)

Q3: From the given front and top views in figure 3, use scale (1:1) to do the isometric (3D) drawing of the "Guide Bearing". (9 Marks)
Q1) A- Simplify the following Boolean functions by means of the tabulation method (Quine-McCluskey): \( P(A,B,C,D,E,F) = (6,9,13,18,19,25,27,29,41,45,57,61) \).

\[ P(A,B,C,D,E,F) = (6,9,13,18,19,25,27,29,41,45,57,61) \]

B- In figure 1 it is required to send the data from \( A \) to \( X \), \( B \) to \( W \), \( C \) to \( Y \), and \( D \) to \( Z \). Re-draw the complete design using Multiplexer and De-multiplexer shared with \( S_1S_0 \).

\[ S_1S_0 \]

\( S_1 \)
\( S_0 \)

\( Y \)
\( W \)
\( X \)

\( Z \)

\( A \)
\( B \)
\( C \)
\( D \)

Figure 1

Q2) A- What are the differences between combinational logic circuits and sequential logic circuits, give an examples for both of them.

B- Complete the timing diagram shown in figure 2.

\[ \text{Clock} \]
\[ 0 \]
\[ 1 \]
\[ 2 \]
\[ 3 \]
\[ 4 \]
\[ 5 \]

\( S \)
\( 0 \)
\( 0 \)

\( R \)
\( 0 \)
\( 0 \)

\( Q \)
\( 0 \)
\( 0 \)

\( \overline{Q} \)
\( 0 \)
\( 0 \)

Figure 2
C- Convert the following numbers.
1- (287)_{10} to BCD
2- (763.65)_{8} to decimal
3- (7562.45)_{10} to binary
4- (4310)_{5} to decimal

Q3) A- Design full subtractor using Decoder and OR gates.

B- Simplify the following Boolean function in product of sum POS and then design with minimal logic gates.

\[ F(A,B,C,D) = \prod (3,4,6,7,11,12,13,14,15) \]

**Practical Part**

Q1\ Use 74151 TTL IC (8 to 1) Multiplexer to create the function shown below and draw the block diagram (D, C and A are selectors).

\[ f(D,C,B,A) = \sum (1,3,5,6,7,10,12,13,14) \]

(8 Marks)

Q2\ Design a display system to display (3 digits) numbers using 7448 TTL IC decoder connected with 7-segment display.

(7 Marks)
Q2-A Write C++ program to copy the Second (50) float elements from the binary file AA.BIN to the end of the text file AA.TXT.

Q2-B Write the global forms of for statement to compensate the do....while statement and do statement?

Q3-A if I: Xz Xo Xs Xn X: Xz Xr Xo Write C++ piece of code that make

J =X1XoX3 X201 X6 X6.

Q3-B What are the differences between binary files and text files, list at least four deferent.

Q4-A Multiple Choice:

1- int a=10,b;b=a++ + ++a;printf("%d,%d,%d,%d",b,++a,a,a++);
what will be the output when following code is executed
A: 20,10,10,10  B: 22,10,11,13  C: 22,11,11,11  D: 22,13,13,14  E: 22,13,13,13

2- 5^ 11 What does the operation shown above produce?
A: 1  B: 6  C: 14  D: 0x0B  E: 0x05

3- jnti = 3 ;int x = 7 ; double z ; z = x / i ;printf("z=%f\n", z);
What will print when the sample code above is executed ?
A: 2  B: 2.5  C: 2.0  D: 0.0  E: 1.0

4- int x = 011 | 0x10 ;
What value will x contain in the sample code above ?
A: 3  B: 13  C: 19  D: 0111  E: 0x111
5- Which of the following will keep asking for a key to be pressed until either "Y" or "N" is pressed, and will then continue with the program?

char ch;

A: do { printf("Y or N: "); ch=getche(ch); } 
while ( ch<> "Y") or ( ch<> "N" );
B: do { printf("Y or N: "); ch=getche(ch); } 
while ( ( ch == Y) || ( ch == N ) );
C: do { printf("Y or N: "); ch=getche(ch); } 
while ( ( ch != 'Y') && ( ch != 'N' ) );

6- int testarray[3][2][2] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12};
What value does testarray[1][3][0] in the sample code above contain?

A: 10  
B: 11  
C: 12

7- What value would be stored in an integer variable "i" as a result of the following calculation:

int i, j=010; i = ++j - j++/ 2;

A: 4  
B: 5  
C: 6

8- According to the Standard C specification, what are the respective minimum sizes (in bytes) of the following three data types: short; int; and long?

A: 1, 2, 4  
B: 2, 2, 4  
C: 2, 4, 8

Practical (15 Marks)

Note: Attempt all question.

Q1 - What is the deference between the use of F2 and F4 in the integrated environment of C++. (3 Marks)

Q2 - Program To Read Three Numbers And Print The Biggest Of Given Three Numbers. (6 Marks)

Q3 - Program to accept 10 numbers and print first five numbers in original order and print last five numbers in reverse order. (6 Marks)

Good luck
[Each question carries equal marks]

Q1 \(A\)- If the total energy \( E_T = \frac{-e^2}{8\pi e r} \) Joule and the atom radius \( r = \frac{\hbar^2 e_0}{e^2 \pi m} \) n\(^2\) meter, prove that the energy difference between the orbits \( n_1 \) and \( n_2 \) is:

\[
\Delta E = E_R \left[ \frac{1}{n_2^2} - \frac{1}{n_1^2} \right], \text{ where } E_R = -\frac{me^4}{8\hbar^2 e_0^2}
\]

\(B\)- Calculate the rotation velocity of the electron in the second orbit in the nuclear system.

Q2 \(A\)- majority (electrons) diffusion current density is \( J_n = e D_n \frac{dn}{dx} \) and the diffusion current of majority carriers is \( I_n = A e D_n \frac{dn}{dx} \). Prove that the ratio of majority to minority diffusion current is \( \frac{D_n}{D_p} = \left| \frac{I_n}{I_p} \right| \).

\(B\)- Describe briefly the basic operation of the Laser diode.

Q3 \(A\)- A silicon PN junction has a hole density in p-side \( 10^{24} \text{m}^{-3} \) and electron density in n-side \( 10^{22} \text{m}^{-3} \), the mobility of the holes is 0.2 m\(^2\)/v.s and the mobility of the electrons is 0.4 m\(^2\)/v.s. The intrinsic concentration equal to \( 10^{19} \text{m}^{-3} \) at 27\(^\circ\)C. If the reverse saturation current equal to 0.2\(\mu\) A and diode voltage 0.25v. Find:

1- The conductivity and resistivity in each side of PN junction.
2- The junction current.

Q4 \(A\)- Describe the work of the light emitting diode and the solar cell?

\(B\)- What are the types of the diode transistor logic gates, explain them?
Q5\ In the transistor circuit shown below, the temperature of the junction is increased from 30°C to 100°C determine the percent change in value of \( I_C \) and \( V_{CE} \). \( \beta = 50 \) at 30°C and \( \beta = 150 \) at 100°C.

\[ I = 50 \text{ at 30°C} \quad \text{and} \quad V = 150 \text{ at 100°C}. \]

Q6\ A- Determine the output voltage waveform for the circuit in figure blow? What is the name of this circuit? \( V_D = 0.7 \text{v}. \)

B- Determine the output voltage waveform for the circuit in figure blow? What is the name of this circuit? \( V_B = 2 \text{v} \), \( V_{B1} = 4 \text{v} \), \( V_{D1} = 0.3 \text{v} \) and \( V_{D2} = 0.7 \text{v}. \)

List of constants:

- Charge of electron=1.6*10^{-19}C
- Permittivity of space=8.85*10^{-12}F/m
- Boltzmann constant=1.38*10^{-23}J/K
- mass of electron=9.1*10^{-31}Kg
- plank's constant=6.626*10^{-34}J.s.
Note: Answer All Questions.

Q1 Answer the following questions: (six only) (12 Marks)
1. What is one familiar use in the phototube?
2. What did the new part of the triode contain? What could it do?
3. What do electronics deal with? What could it do?
4. What is a compass?
5. What are the two kinds of current? How are they different from each other?
6. How are amperes and ohms defined in numerical terms?
7. How does electrolysis work?

Q2 Fill in the spaces with the correct word or phrase: (six only) (12 Marks)
1. The atomic number of an element indicates the number of _______ and _______ that the atom contains.
2. The scientists experimenting with electromagnetism found that the magnetic effect of an electric current could be strengthened by sending the current through a _______.
3. _______ is a navigational system that can locate aircraft. While _______ is a navigational system that can locate underwater objects.
4. The two systems for modifying radio waves to carry sound waves are _______ and _______.
5. Volta made his experimental cell in 1800 producing for the first time a _______ _______ electric current.
6. The household electricity is connected by a _______ circuit because _______.
7. A _______ is a tiny particle of matter which is made up of a combination of atoms.

Q3 Decide if these statements are true or false: (six only) (12 Marks)
1. Mica is a transparent mineral window protects the fuse in the circuit.
2. The center of the atom is a nucleus which contains almost the entire weight or mass of the atom.
3. The crystal detector is more accurate than diode in detecting radio signals.
4. Electricity and electronics are really indivisible each one forms part of the other.
5. A magnet exerts a force of attraction in a straight line from one pole to the other.
6. Atomic fission is joining together of atomic nuclei with a great release of energy.
7. There is no partial vacuum within the electric light bulb.
Q4 Select a word from the three alternatives given which is most similar in meaning to the words in italic: (six only) (12 Marks)

1. Mining engineering is the branch of engineering includes activities related to the discovery of mineral deposits. (comprises, deals, contains)
2. Electrical conductivity is the ability to conduct electrical current under the application of voltage which has the one of the widest ranges of values of any physical property of matter. (travel, characteristic, include)
3. The compact fluorescent bulb is seen as an interim solution because the bulbs contain mercury and so present a potential pollution hazard. (conduct, flow, glow)
4. Fiber optics are light signals that enter at one end of a fiber travel through the fiber with very low loss of light. (flow, transmit, extend)
5. Local telephone service provides the use of fiber optic cables between central offices and some times extend it onto neighborhoods and even homes. (reflect, transmit, expand)
6. The commutator reverses the electron flow changing the magnetic poles of the armature at each half turn. This causes the armature to move on to the new poles of attraction completing a full rotation. (loop, cycle, through)
7. Sound waves are converted into electrical vibrations which are used to adapt these waves. (modulate, change, rotate)

Q5 Complete the gaps with the correct word: (six only) (12 Marks)
(coated, disadvantage, released, semiconductor, glow, bulb, theoretical)

1. Phototube is a tube which electrons are by the energy of light.
2. Silicon is one of the substances that classed as__________.
3. Transistors overcome most of the__________ of vacuum tubes.
4. Engineers make practical applications of the findings of _________ or pure science such as physics or chemistry.
5. In the early 1950s Abraham Van Hell introduced cladding as a way to reduce light loss in glass fibers. He__________ his fiber with plastic.
6. The most familiar example of an incandescent lamp is the common household__________.
7. When electric current flows through the filament of tungsten it heats the filament to a temperature of about 3000c causing the filament to _________ and provide the light.

Good Luck
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1. Mining engineering is the branch of engineering includes activities related to the discovery of mineral deposits. (comprises, deals, contains)
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Good Luck
Note: - Answer all the questions.

Q1: Fill in the blank with suitable phrase. (10 Marks)
1- ..................A multi-user computer capable of supporting from 10 to hundreds of users simultaneously.
2- ..........................is a device that can protect a computer from problems caused by changes in power (power fluctuation).
3- Some CPUs incorporate............... to enhance the performance of the CPU. With this term the CPU has multiple pieces of code being executed simultaneously on each pipeline.
4- ..............is a high-speed, hot-swappable interface that can support up to 63 devices. Some devices can also be powered through this port.
5- ..........................is a set of guidelines used by programmers to ensure that the application they are developing is compatible with an operating system.
6- ..............It is also called a file allocation unit. It is the smallest unit of space used for storing data in hard disk.
7- All computers rely on .........................to provide the interface for interaction among users, applications, and hardware.
8- One of the biggest power consumers on a laptop is.................
9- ..........port connects a keyboard or a mouse to a computer. This port is a 6-pin mini-DIN female connector.
10- ..................is a 32-bit or 64-bit expansion slot. It is the standard slot currently used in most computers.

Q2:A. Answer three of the following questions: (6 Marks)
1. What is the major difference between desktop and laptop motherboards?
2. What is the difference between standby and Hibernate?
3. List three common laptop features?
4. How can improve printing speed and allow the printer to handle more complex print jobs?

B. Define five of the following: (5 Mark)
Nozzles, scanner head, packet switching, throttling, APM, feeding mechanism

Q3: A. What are the functions of the following? (6 Mark)
1- protocols
2- Hardware Compatibility List (HCL).
3- access points.
4- Dynamic Host Configuration Protocol (DHCP).

B. State the reason of the following. (8 Marks)
1- Laptop processors don’t require cooling devices that are large as these found in desktop.
2- Each computer on the network does not need its own printer, scanner, or backup device.
3- Individual network users do not need to manage their own data and devices.
4- The twisted wires provide protection against crosstalk.
**Practical part**

Q4: Choose the correct answer/s for the questions below: (5 Mark)

1. A technician wishes to boot a computer using a CD-ROM that contains a limited operating system and diagnostic utilities. Where would the technician set the boot order for the PC?
   - My Computer
   - Control Panel
   - Device Manager
   - BIOS
   - Start Menu

2. Which important feature is offered by the USB standard?
   - A single USB connection to a computer can support up to 255 separate devices.
   - It offers rates of around 580 Mb/sec in low-speed mode.
   - It allows up to 920 Mb/sec in the 2.0 version.
   - It can supply power from the computer to devices.

3. | Steps | Description |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Insert the power supply into the case.</td>
</tr>
<tr>
<td>2</td>
<td>Connect the power cord to the power supply.</td>
</tr>
<tr>
<td>3</td>
<td>Secure the power supply to the case using the proper screws.</td>
</tr>
<tr>
<td>4</td>
<td>Align the holes in the power supply with the holes in the case.</td>
</tr>
</tbody>
</table>

Refer to the exhibit. What is the order of steps that should be followed for a power supply installation in a computer?

- Steps 1, 2, 4
- Steps 1, 3, 2
- Steps 1, 4, 3
- Steps 2, 3, 4

4. Which directory contains Windows XP OS system files?
   - C:\WINNT
   - C:\WINDOWS
   - C:\Program Files
   - C:\Documents and Setting

Q5: Answer the questions below by write (TRUE) or (FALSE) and correct the false if there is: (5 Mark)

1- crossover UTP is used to connect computer to switch.
2- disk cleanup is designed to increase access speed by rearranging files stored on a disk to occupy contiguous storage locations.
3- The IP 127.0.0.1 is used to test that the LAN card on computer is working.
4- Windows XP is commonly used name for a command-line utility that provides disk partitioning functions.
5- Ping in Microsoft Windows is a console application that displays all current TCP/IP network configuration value.

Q6: Answer the following questions: (5 Mark)

A- what is the difference between obtaining IP address dynamically and use static IP?
B- Consider having a new computer and want to connect it to internet, step by step prepare it and then test that is connected correctly.
ملاحظة: الأسئلة ثلاث صفحات

س1: للدائرة أعلاه حدد كل من (Ch1, Ch2, Com)

R1,L1, R2, L1, C1, C2, R3.

- A- للدائرة

S2: ارسم فولتيمتر العلامة L من خلال الرسم أعلاه. إذا ما ان H:

S3: أجريت قياسات للتيار عند تغيير مقاومة الحمل لإحدى شبكات التيار المستمر الكهربائية وكانت القياسات كما في الجدول أعلاه. اوجد مكافئ تقليل الدائرة المعنوية للحمل.

<table>
<thead>
<tr>
<th>RL</th>
<th>0</th>
<th>200Ω</th>
<th>500Ω</th>
<th>750Ω</th>
<th>1 kΩ</th>
<th>1.5 kΩ</th>
<th>2 kΩ</th>
<th>2.5 kΩ</th>
<th>3 kΩ</th>
<th>3.5 kΩ</th>
<th>4 kΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL(mA)</td>
<td>3.5</td>
<td>3.2</td>
<td>2.8</td>
<td>2.5</td>
<td>2.3</td>
<td>2</td>
<td>1.75</td>
<td>1.5</td>
<td>1.4</td>
<td>1.27</td>
<td>1.16</td>
</tr>
</tbody>
</table>
س4: جد قيمة R من الرسم أدناه:

س5: اوجد زاوية فرق الطور بين الموجتين A و B للموجة A & B ثم اوجد التردد. 

عندما أن Vrms = 2 V

Time Scale (0.2msec/DIV)
Voltage Scale (0.5V/DIV)

س6: الشبكة الكهربائية التالية، ما هي خطوات قياس مكافئ تقن عملياً؟

س7: اختبر الإجابة الصحيحة لكل مما يأتى:

1. تقوب لوحة Breadboard المستخدمة لإجراء تجارب المختبر:
   a. متصلة مع بعضها أفقياً  
   b. متصلة مع بعضها عمودياً
   c. متصلة مع بعضها أفقياً و عمودياً
   d. لا يوجد
2. يحصل أعمد نقل للقدرة عندما:
   a. RL=4Rb  
   b. RL=2Rb  
   c. RL=Rb  
3. المقاومة الداخلية لجهاز الراسة:
   a. كبيرة جداً  
   b. صغرى جداً  
   c. متوسطة  
   d. ليست مهمة
س8: للدائرة المبينة في الشكل، تم شحن المتسعة لفترة زمنية طويلة، تم فتح المفتاح s عند الزمن t=0 فكانت قراءات فولتية المتسعة (VC) مع الزمن (t) كما في الجدول أدناه. حدد قيمة R المجهولة.

<table>
<thead>
<tr>
<th>t(msec)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>40</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>VC(Volt)</td>
<td>6</td>
<td>3.6</td>
<td>2.22</td>
<td>1.3</td>
<td>0.8</td>
<td>0.49</td>
<td>0.29</td>
<td>0.1</td>
<td>0.04</td>
</tr>
</tbody>
</table>

س9: للدائرة التالية:

1. أعد رسم الدائرة مبيناً اتجاه التيار الميار في المقاومة R1
2. حدد قيمة المقاومة R1

س10: ما هو العنصر المفقود في الدائرة التالية؟ و لماذا؟
Attempt All questions

Q1- The information in an analog waveform is first encoded into binary PCM and then converted to a multilevel signal for transmission over the channel. The number of multilevels is eight. Assume that the analog signal has a bandwidth of 2700 Hz and is to be reproduced at the receiver output with an accuracy of ±1% of full scale.
   a- Determine the min bit rate of the PCM signal.
   b- Determine the min baud rate of the multilevel signal.
   c- Determine the min channel bandwidth required for transmission of this PCM signal.

Q2- For the signal whose quantized sample values are {1, 2, 4, 6, 8, 10, 12, 14}, assuming zero initial value, find the transmitted sequences if we use
   a- DPCM
   b- Delta modulation

Q3- A discrete memoryless source has an alphabet of size 7 with probabilities 0.02, 0.11, 0.07, 0.21, 0.15, 0.19, 0.25.
   a- Determine the entropy of this source.
   b- Design a Huffman code of this source, and determine the efficiency of the code.

Q4- Answer the following questions:
   a- Explain briefly how can be reduced in digital communication.
   b- Explain briefly QPSK.
   c- Define forward error correction

Q5- A random variable x has a PDF
   \[ p(x) = \frac{3(-x^2 + 8x - 12)}{32} \]  for 2 < x < 6 and 0 elsewhere
   a- Demonstrate that p(x) is a valid PDF
   b- Find the mean
   c- Find the standard deviation
Q1.

A. What is the Voltage follower? Explain in details.

B. Using OP AMP, Design the following mathematical equation:

\[ \text{Output} = \int X \times Y \]  

(12 Marks)

Q2.

A. There are limitations on the performance of OP-amp circuits when large output signals are present. What are these limitations? Explain briefly.

B. Consider an OP amp connected in the inverting configuration to realize a closed-loop gain of -50 V/V utilizing resistors of 1 kΩ and 50 kΩ. A load resistance R_L is connected from the output to ground, and a low-frequency sine wave signal of peak amplitude V_p is applied to the input. Let the OP amp be ideal except that its output voltage saturates at +/-10 V and its output current is limited to the range +/-15 mA.

i. For R_L = 1 kΩ, what is the maximum possible value of V_p while an undistorted output sinusoid is obtained?

ii. If it is desired to obtain an output sinusoid of 10-V peak amplitude, what minimum value of R_L is allowed?

(12 Marks)

Q3: For the Binary-Weighted 4-bit DAC shown below. The largest desired analoge output is to be 5 volt, and the largest resistor used is 32 kΩ.

A. Specify the elements of the DAC.
B. What is the Max current in the feedback resistor of OP amp
C. What is the Min voltage that can be resolved

(12 Marks)
Q4.
A. What are the advantages of using ECL logic compared to TTL Logic?
B. Design the following logic equations using ECL:

\[ Y = (A + B) \cdot C \]
\[ Y = (A + B) \cdot C \]

(12 Marks)

Q5.
A. Explain the principle operation of Astable, Monostable and Bistable Multivibrators. Draw the circuit of each.
B. For 555 Timer IC operates on monostable mode. If \( R_1 = 3.5 \text{KΩ} \) and \( C_1 = 0.5 \text{μF} \), find Pulse width and frequency.

(12 Marks)

Good Luck
[Note: Answer all Questions]

Q1 – Given 3 processes A, B, C and a small dispatcher program where:
   4000 = starting address of program of process A with (20) instructions
   7000 = starting address of program of process B with (8) instructions
   13000 = starting address of program of process C with (16) instructions
   100 = starting address of dispatcher program with (6) instructions

Draw the interleaved trace of processes showing the instruction cycles assuming no use of virtual memory.

[12 marks]

Q2 – Explain in your own words and with the help of figures how to get a better utilization of multiprocessor architecture.

[12 marks]

Q3 – Suppose that the processor has access to two levels of memory. Level 1 contains 1,000 bytes and has an access time of 0.12 μs; level 2 contains 100,000 bytes and has an access time of 1.2 μs. Calculate the average time to access a byte for the following cases:

(a) If 98% of the memory accesses are found in the cache.
(b) If the Hit Ratio is 65%.
(c) Discuss the results obtained in (a) and (b) using figure when necessary.

(Note: Ignore the time required for the processor to determine whether the byte is in level 1 and level 2).

[12 marks]

Q4 - Current multi-core vendors offer systems with up to eight cores on a single chip. Explain how to achieve the potential for parallelism in their design.

[12 marks]

Q5 - Commercial VM offerings by companies such as VMware and Microsoft are widely used. Explain with the help of figure a typical arrangement of VM technology.

[12 marks]

Good Luck
Q1)
A. What is the result of the used registers after executing the following piece of code:

```
MOV Al, 80
MOVSX EAX, Al
CDQ
```

[4 marks]

B. Counter 0 address of 82C54 is F300h while the address of control register is F3C0h.
Write a piece of code to program Counter 2 as the same as of Counter 0 with initial count
of 2220h. **Note:** Counter 0 is previously programmed.

[6 marks]

Q2)
A 4x4 hexadecimal keypad, shift, control keys and 8 digits display (left entry) are
interfaced to the 82C79 at base address R00h (two ports F300h and F302h). Write a piece
of code to display each key pressed (of the keypad) on the display. Use shift key to erase
the last key pressed and the control key to erase the whole display. Make any assumptions you
need. **Note:** the initialization of the 82C79 is not required, and the ninth digit entered
updates the first digit.

[10 marks]

Q3)
A. Explain briefly the types of RAM memory test?

[4 marks]

B. Write an assembly program to print the checksum (in hexadecimal) of 64Kbyte of
EPROM which starts at address F0000h. **Note:** The ASCII code of '0' is 30h and of 'A'
is 41h.

[6 marks]

Q4) 8086 microprocessor is to be used in a dedicated controller application as shown in figure 1.
Refer to figure 2:
1. Write an assembly subroutine to initialize the PPI. Port-A is to be programmed to operate
as strobed input with interrupt enable, while Port-B as basic output.

[2 marks]

2. Write an assembly subroutine to initialize the Timer. Counter-0 and Counter-1 are to be
programmed to generate square waves with 1 KHz and 500 KHz respectively.

[2 marks]

3. Write an assembly subroutine to initialize the PIC. IRQ7 will generate interrupt number
77h.

[2 marks]

4. Write a piece of code to realize the digital filter. Use 5-bits fixed point arithmetic.

[4 marks]

Q5)
A. How the physical address of the 80386 microprocessor is computed in real-mode and
protected-mode?

[5 marks]

B. State the steps required to switch from real mode to protected mode?

[5 marks]
Figure 1

\[ H(z) = \frac{Y(z)}{X(z)} = \frac{1 + 0.325z^{-1} + 0.475z^{-2}}{1 + 0.235z^{-1} + 0.625z^{-2}} \]

1 KHz Sampling Frequency
1. PPI 8255

Mode definition (D7 = 1)

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bit Set / Reset (D7 = 0)**

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bit Number  

5 Set  

0 Reset

Timer 8254

**Control Word Format**

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC1</td>
<td>SC0</td>
<td>RW1</td>
<td>RW0</td>
<td>M2</td>
<td>M1</td>
<td>M0</td>
<td>BCD</td>
</tr>
</tbody>
</table>

Select Counter  
Read/Write Mode  
Mode of Operation  
Type of Counting

**Read Back Command**

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Status Byte Format

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0/p</td>
<td>Null</td>
<td>RW1</td>
<td>RW0</td>
<td>M2</td>
<td>M1</td>
<td>M0</td>
<td>BCD</td>
</tr>
</tbody>
</table>

PIC 8259

**ICW1 A0 = 0**

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A6</td>
<td>A6</td>
<td>A5</td>
<td>1</td>
<td>LTIM</td>
<td>ADI</td>
<td>SNGL</td>
<td>IC4</td>
</tr>
</tbody>
</table>

**ICW2 A0 = 1**

<table>
<thead>
<tr>
<th>D7</th>
<th>D6</th>
<th>D5</th>
<th>D4</th>
<th>D3</th>
<th>D2</th>
<th>D1</th>
<th>D0</th>
</tr>
</thead>
<tbody>
<tr>
<td>A15</td>
<td>A14</td>
<td>A13</td>
<td>A12</td>
<td>A11</td>
<td>A10</td>
<td>A9</td>
<td>A8</td>
</tr>
</tbody>
</table>
**ICW3 \( A_0 = 1 \) (Master Device)**

<table>
<thead>
<tr>
<th>S7</th>
<th>S6</th>
<th>S5</th>
<th>S4</th>
<th>S3</th>
<th>S2</th>
<th>S1</th>
<th>S0</th>
</tr>
</thead>
</table>

**ICW4 \( A_0 = 1 \)**

| 0  | 0  | 0  | 0  | SFN | BUF | MS  | AEOI | \( \mu \) |

**OCW1 \( A_0 = 1 \)**

| M7 | M6 | M5 | M4 | M3 | M2 | M1 | M0 |

**OCW2 \( A_0 = 0 \)**

| R  | SL | EOI | 0  | 0  | L2 | L1 | L0 |

---

### 16550 UART

**Line Control Register**

| DL | Send Break | Stick Bit | P | PE | Stop Bit | L1 | L0 |

**Line Status Register**

| ER | TE | TH | BI | FE | PE | OE | DR |

**Interrupt Enable Register**

| 0  | 0  | 0  | 0  | MOD | Line Status | Tx | Rx |

**Interrupt Identification Register**

| 0  | 0  | 0  | 0  | 0  | X  | X  | 1  |

- No Interrupt
- Receiver Line Status
- Received Data
- Transmitter Holding Reg. Empty
- MODEM
1. Answer only three of the following:

A. Give an advantage of a pipelined design over (i) a single cycle and (ii) a multicycle design.

B. Which is TRUE about a pipelined processor? Explain the reason for FALSE statements.
   (i) Adding more pipeline stages usually increases the number of control and data hazards.
   (ii) Latch overheads do not limit the maximum number of stages in a pipeline.
   (iii) Adding more pipeline stages always improves performance.
   (iv) Changing the number of pipeline stages typically requires changing the instruction set.

C. A non-pipelined processor takes 14ns to execute an instruction.
   (i) How many pipeline stages are needed for the processor to run at 1GHz clock rate with 0.3ns latch delay?
   (ii) With the given clock rate 1GHz, what is the maximum speedup that can be achieved by the pipelined processor compared to the nonpipelined processor?
   (iii) What is the average CPI for 30-instruction program for this pipelined processor? (Assume no data/control hazards.)
   (iv) Worst case scenario for the pipelined processor when there are maximum stalls which only allows one instruction in the pipeline. What is the worst case slowdown/speedup ratio for the pipelined processor?

D. Explain why branch type instructions can cause problems in instruction pipelines. Also discuss how the delayed branch technique used by RISC processors avoids these problems with branch instructions.

2. A. Consider two different implementation, P1 and P2, of the same instruction set architecture. There are five classes of instructions (A, B, C, D and E) in the instruction set. The clock rate and CPI of each implementation are given in the following table.

<table>
<thead>
<tr>
<th></th>
<th>Clock Rate</th>
<th>CPI Class A</th>
<th>CPI Class B</th>
<th>CPI Class C</th>
<th>CPI Class D</th>
<th>CPI Class E</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2.0 GHz</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>P2</td>
<td>4.0 GHz</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

   (i) Given a program with instructions only of class A, which implementation is faster?
   (ii) If the number of instructions executed in a certain program is divided equally among the classes of the instructions except for class A, which occurs twice as often as each of the others, which computer is faster? How much faster is it?

B. Suppose a single cycle design uses a clock period of 5ns. A multicycle version of the same design will require a clock period of 1ns. In the multicycle design, an ALU operation will take 3 cycles, loads will take 5 cycles, stores will take 3 cycles, and branches will take 2 cycles. Suppose an example program of 1000 instructions long contains 50% ALU instructions, 20% loads, 20% stores, and 10% branches. What is the speedup for the multicycle design over the single cycle design?

3. A. What is the locality principle? How does it influence the design and operation of a cache?
   B. Consider a memory system that uses a 32-bit address to address at the byte level, plus a cache that uses a 64-byte line size.
(i) Assume a direct mapped cache with a tag field in the address of 20 bits. Show the address format and determine the following parameters: number of addressable units, number of block in main memory, number of lines in cache, size of tag.

(ii) Assume an associative cache. Show the address format and determine the following parameters: number of addressable units, number of block in main memory, number of lines in cache, size of tag.

(4+10) Marks

4. A. Design the hardware described by the following register transfer statements:
   \[
   \begin{align*}
   Xrxt:nev[Rn] \\
   Xrxr:ReRc \\
   Xrxu:M[AR]+R
   \end{align*}
   \]

B. The microprogrammed control unit shown below uses a control memory of 64x20 bits. The microoperations field have 9 bits.

(i) According to the table below, design the input logic circuit shown in the above figure.

(ii) If there are 4-status bits, how many bits are there in the AD, CD and BR fields?

(iii) Show how the microoperation field can be divided into subfields to specify 46 microoperations. How many microoperations can be specified in one microinstruction?

<table>
<thead>
<tr>
<th>BR</th>
<th>CAR&lt;AD</th>
<th>CAR&lt;CAR+1</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>CAR&lt;AD</td>
<td>CAR&lt;CAR+1</td>
<td>if condition=1</td>
</tr>
<tr>
<td>001</td>
<td>CAR&lt;AD, SBR&lt;CAR+1</td>
<td>CAR&lt;CAR+1</td>
<td>if condition=0</td>
</tr>
<tr>
<td>010</td>
<td>CAR&lt;6B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>011</td>
<td>CAR(1-4)&lt;DR(11-14), CAR(0,5)&lt;0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>CAR&lt;CAR+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>CAR&lt;AD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11X</td>
<td>CAR&lt;AD, SBR&lt;CAR+1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. Draw the circuit diagram for the PC in the single cycle computer. The inputs are: contents of register A, output of sign extend, Clock, and selector from branch control (2 bits), where 00 means PC ← PC + 1, 01 means PC ← R[SA] and 10 means PC ← PC + se AD.

(6+10+6) Marks
1. Answer only three of the following:
   A. Give an advantage of a pipelined design over (i) a single cycle and (ii) a multicycle design.
   B. Which is TRUE about a pipelined processor? Explain the reason for FALSE statements.
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(4+4+4) Marks

2. Consider two different implementation, P1 and P2, of the same instruction set architecture. There are five classes of instructions (A, B, C, D and E) in the instruction set. The clock rate and CPI of each implementation are given in the following table.

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<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>P2</td>
<td>4.0 GHz</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
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(i) Given a program with instructions only of class A, which implementation is faster?
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(6+6) Marks

3. A. What is the locality principle? How does it influence the design and operation of a cache?
   B. Consider a memory system that uses a 32-bit address to address at the byte level, plus a cache that uses a 64-byte line size.
PART-1(Q1, Q2)
Answer all questions

Q1
1-1- Design a digital lowpass Butterworth filter with the following specifications... (10 Marks)
- 3 dB attenuation at the passband frequency of 1.5 kHz
- 10 dB stopband attenuation at the frequency of 3 kHz
- Sampling frequency of 8,000 Hz
- Calculate frequency response (magnitude) at 1 KHz and at the start of stopband frequency

1-2- Design a notch filter to remove power supply interferences (50 Hz)... (10 Marks)
- With the following Specifications
  - Sampling frequency 1 kHz
  - 3 dB bandwidth = 4 Hz
  - Centre frequency = 50 Hz
  - Find the transfer function using pole-zero method
  - Find frequency response (magnitude) at 50 Hz and 100 Hz
  - Realize the filter using direct form II

Q2
Design a 5- tap FIR lowpass filter with cutoff frequency 1500... (20 Marks)
And sampling rate of 8000Hz using
- Hamming window
- Blackman window
- Determine the transfer functions and difference equation for both windows
- Compute the magnitude frequency response at 1000Hz and 4000 Hz for both windows

PART-2 (Q3, Q4, Q5, Q6)
Answer any three questions

Q3
3-1-The transfer function for practical reconstruction DAC (ZOH) is ... (10 Marks)

\[ H_b(s) = \frac{1 - e^{-sT}}{s} \]

- Prove that

3-2-for the signal \( x(t) = 4.5 \sin(2500\pi t) \) ... (10 Marks)
- Determine the number of bits for ADC (0-10V) to have \( SNR_{db} = 45 \)
- The minimum sampling frequency
- The digital value and quantization error for \( x(t) \) at \( t = 1/5000 \) Sec

\[ SNR_{db} = 10.79 + 20 \cdot \log_{10} \left( \frac{X_{rms}}{\Delta} \right) \]

Q4
4-1- Draw the Z-Plane corresponding to the following S-Plane Coordinates ... (10 Marks)
- \( \sigma = 0, W = (W_s/2 \rightarrow -W_s/2) \)
- \( \sigma = 0 \rightarrow -\infty, W = 0 \)
- \( \sigma = 0 \rightarrow \infty, W = 0 \)
4-2 find Z-transforms inverse using partial fraction method for ... (10 Marks)

\[ X(z) = \frac{1}{(1 - z^{-1})(1 - 0.5z^{-1})}. \]

Q5
5-1 Given impulse response for the system as shown ... (10 Marks)

\[ h(0) = 1, \quad h(1) = 2, \quad h(2) = 2, \quad h(3) = 4 \]

- Find the response for the system for unit step input using convolution table method
- Find the response for the system for unit step input using convolution theorem

(Using Z-Transform for unit step \( u(n) = 1 + z^{-1} + z^{-2} + z^{-3} \))

5-2 For the signals ... (10 Marks)

\[ x(n) = 1101, \quad y(n) = 1001 \]

- Evaluate DFT \( X(k) \) and DFT \( Y(K) \) using the decimation-in-frequency FFT method.
- Calculate cross correlation using correlation theorem

Q6
6-1 For the signal as shown in Fig.2 ... (10 Marks)

- Calculate and draw Fourier transform (FT) (magnitude only)
- Calculate and draw discrete Fourier transform (DFT) using FFT for

The signal sampled by 4 Hz (taken 4 samples 1111)

6-2 For the circuit shown in Fig.1, \( R=100000 \Omega, \quad C=1 \mu \) ... (10 Marks)

- Draw frequency response (magnitude) using Laplace transform and calculate cut off frequency
- Find Z-Transform for the circuit using BLT Method and draw spectrum (magnitude)

At \( (0, 1, 5) \) Hz using \( Fs=100Hz \)

Dr Saad Daoud Al-Shamma
Data Sheets

Butterworth Filter Design

\[ E^2 = 10^{0.1A_p} - 1 \]

\[
 n \geq \frac{\log_{10} \left( \frac{10^{0.1A_p} - 1}{E^2} \right)}{2 \cdot \log_{10} (v_x)}
\]

TABLE 8.1 Analog lowpass prototype transformations.

<table>
<thead>
<tr>
<th>Filter Type</th>
<th>Prototype Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowpass</td>
<td>( \frac{s}{\omega_c}, \omega_c \text{ is the cutoff frequency} )</td>
</tr>
<tr>
<td>Highpass</td>
<td>( \frac{\omega_c}{s}, \omega_c \text{ is the cutoff frequency} )</td>
</tr>
<tr>
<td>Bandpass</td>
<td>( \frac{s^2 + \omega_0^2}{sW}, \omega_0 = \sqrt{\omega_1 \omega_2}, W = \omega_2 - \omega_1 )</td>
</tr>
<tr>
<td>Bandstop</td>
<td>( \frac{sW}{s^2 + \omega_0^2}, \omega_0 = \sqrt{\omega_1 \omega_2}, W = \omega_2 - \omega_1 )</td>
</tr>
</tbody>
</table>

Analog Filter Specifications

<table>
<thead>
<tr>
<th>Lowpass: ( \omega_{ap}, \omega_{as} )</th>
<th>Lowpass Prototype Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_p = 1, v_s = \omega_{as}/\omega_{ap} )</td>
<td></td>
</tr>
<tr>
<td>( v_p = 1, v_s = \omega_{ap}/\omega_{as} )</td>
<td></td>
</tr>
<tr>
<td>( v_p = 1, v_s = \frac{\omega_{ah} - \omega_{al}}{\omega_{ap} - \omega_{al}} )</td>
<td></td>
</tr>
<tr>
<td>( v_p = 1, v_s = \frac{\omega_{ah} - \omega_{al}}{\omega_{ah} - \omega_{al}} )</td>
<td></td>
</tr>
</tbody>
</table>

\( \omega_{ap} \), passband frequency edge; \( \omega_{as} \), stopband frequency edge; \( \omega_{ap} \), lower cutoff frequency in passband; \( \omega_{ah} \), upper cutoff frequency in passband; \( \omega_{al} \), lower cutoff frequency in stopband; \( \omega_{ah} \), upper cutoff frequency in stopband; \( \omega_n \), geometric center frequency.

Notch Filter Design

\[ r \approx 1 - \left( BW_{3dB}/f_s \right) \times \pi, \text{ good for } 0.9 \leq r < 1 \]

\[ \theta = \left( \frac{f_0}{f_s} \right) \times 360^\circ \]
\[ H(z) = \frac{K(z - e^{j\theta})(z + e^{-j\theta})}{(z - re^{j\theta})(z - re^{-j\theta})} = \frac{K(z^2 - 2z \cos \theta + 1)}{(z^2 - 2rz \cos \theta + r^2)}. \]

\[ K = \frac{(1 - 2r \cos \theta + r^2)}{(2 - 2 \cos \theta)}. \]

### FIR Window Design

**Hamming window:**
\[ w_{\text{ham}}(n) = 0.54 + 0.46 \cos \left( \frac{n\pi}{M} \right), \quad -M \leq n \leq M. \]

**Blackman window:**
\[ w_{\text{black}}(n) = 0.42 + 0.5 \cos \left( \frac{n\pi}{M} \right) + 0.08 \cos \left( \frac{2n\pi}{M} \right), \quad -M \leq n \leq M. \]

**High pass:**
\[ h(n) = \begin{cases} 0 & n = 0 \\ \frac{\pi - \Omega_c}{\sin (\Omega_c \pi)} & \text{for } n \neq 0 \quad -M \leq n \leq M \end{cases} \]

**Lowpass:**
\[ h(n) = \begin{cases} \frac{\Omega_c}{\sin (\Omega_c \pi)} & n = 0 \\ -\frac{\sin (\Omega_c \pi)}{\sin (\Omega_c \pi)} & \text{for } n \neq 0 \quad -M \leq n \leq M \end{cases} \]

\[ f_c = (f_{\text{pass}} + f_{\text{stop}})/2. \]

\[ \Delta f = |f_{\text{stop}} - f_{\text{pass}}|/f_s, \]

### TABLE 7.7 FIR filter length estimation using window functions (normalized transition width \( \Delta f = |f_{\text{stop}} - f_{\text{pass}}|/f_s \)).

<table>
<thead>
<tr>
<th>Window Type</th>
<th>Window Function ( w(n), -M \leq n \leq M )</th>
<th>Window Length, ( N )</th>
<th>Passband Ripple (dB)</th>
<th>Stopband Attenuation (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangular</td>
<td>1 ( + 0.5 \cos \left( \frac{n\pi}{M} \right) )</td>
<td>( N = 0.9/\Delta f )</td>
<td>0.7416</td>
<td>21</td>
</tr>
<tr>
<td>Hanning</td>
<td>0.5 + 0.5 ( \cos \left( \frac{n\pi}{M} \right) )</td>
<td>( N = 3.1/\Delta f )</td>
<td>0.0546</td>
<td>44</td>
</tr>
<tr>
<td>Hamming</td>
<td>0.54 + 0.46 ( \cos \left( \frac{n\pi}{M} \right) )</td>
<td>( N = 3.3/\Delta f )</td>
<td>0.0194</td>
<td>53</td>
</tr>
<tr>
<td>Blackman</td>
<td>0.42 + 0.5 ( \cos \left( \frac{n\pi}{M} \right) ) + 0.08 ( \cos \left( \frac{2n\pi}{M} \right) )</td>
<td>( N = 5.5/\Delta f )</td>
<td>0.0017</td>
<td>74</td>
</tr>
</tbody>
</table>

### Z-TRANSFORM

\[ au(n) \quad \frac{dz}{z - a} \quad \frac{z}{z - a} \]

**Convolution Theorem**
\[ \sum_{k=0}^{\infty} x_1(k)x_2(n-k) \Leftrightarrow X_1(z)X_2(z) \]

<table>
<thead>
<tr>
<th>Bit index</th>
<th>FFT</th>
<th>Bit reversal</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>01</td>
<td>X(0) 00</td>
</tr>
<tr>
<td>01</td>
<td>2</td>
<td>X(2) 10</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>X(1) 01</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>X(3) 11</td>
</tr>
<tr>
<td>Bit index</td>
<td>INVERSE FFT</td>
<td>Bit reversal</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>--------------</td>
</tr>
<tr>
<td>00 X(0)</td>
<td></td>
<td>x(0) 00</td>
</tr>
<tr>
<td>01 X(1)</td>
<td></td>
<td>x(2) 10</td>
</tr>
<tr>
<td>10 X(2)</td>
<td></td>
<td>x(1) 01</td>
</tr>
<tr>
<td>11 X(3)</td>
<td></td>
<td>x(4) 11</td>
</tr>
</tbody>
</table>

**DFT**

\[
W_N = e^{-j2\pi/N} = \cos\left(\frac{2\pi}{N}\right) - j \sin\left(\frac{2\pi}{N}\right).
\]

\[
X(k) = \sum_{n=0}^{N-1} x(n)e^{-j2\pi kn/N} = \sum_{n=0}^{N-1} x(n)W_N^{kn}, \text{ for } k = 0, 1, \ldots, N - 1.
\]

---

**Fig. 1**

- Circuit diagram showing a voltage source \( V_i \), resistor \( R \), and output voltage \( V_o \).

**Fig. 2**

- Diagram showing an amplifier and a time axis labeled 1SEC.
Part I: Computer Network Lab

Q1- what is the plug-and-play system and briefly explain how to override it regarding the IRQ.
? [2 Marks]

Q2- which of the following sentences is correct, if not rewrite the correct one. [4 Marks]
  a- If a full IOS image cannot be located in the router flash memory, the next step a scale down version of the IOS is copied from ROM into RAM .
  b- IP guarantees the delivery of the packet to its destination using acknowledgment.
  c- HTTP protocol use UDP port 80 by default.
  d- In automatic allocation the DHCP server permanently assigns a static IP address to requesting client based on the client MAC address.

Q3- For the following network topology : [4 Marks]

a- How many broadcast domain?

b- How many collision domain?

c- The administrator of the above network topology was given the network address 192.168.10.0/24 , this network should be subnetted to satisfy the topology requirements.
Part II: Electronics and Communication Lab.

Q1- Regarding the following diagram, when the Sampling Clock is 20KHz the maximum frequency of the signal source should be 2.5KHz to get an undistorted signal at point 3. Justify this fact. [3 Marks]

Q2- Design a circuit that can solve the following equation using op-amp adder and subtractor

\[ V_{out} = -2V_1 + (V_2 - V_1) \]  [3 Marks]

Q3- Choose the Correct Answer [4 Marks]

1- \( Z_0 \) of the OPA in the ideal case shall be
   a. \( \infty \).
   b. 1MΩ.
   c. 0 Ω.

2- In Frequency Modulation the Greek letter beta(\( \beta \)) is defined by
   a. the ratio of deviation to maximum modulating frequency
   b. the ratio of deviation to minimum modulating frequency
   c. FM signal bandwidth

3- Which of the following statement is not correct about (SR) slew rate
   a. Smaller SR corresponds to slower transmission of the signal.
   b. Smaller SR corresponds to quicker transmission of the signal.
   c. Larger SR corresponds to higher capability to handle high-frequency signal.

4- The main disadvantage of the envelope detector is
   a. Its noise immunity is very weak
   b. It will add noise to the signal
   c. Did not work with high frequency signals
Part III: DSP

Q1:

a- Suggest the expected output of following MATLAB code.(2 marks)

```matlab
clear
fs=200;
t=-1:0.001:1;
ts=1/fs;
n=-1/ts:1/ts;
signal=cos(2*pi*5*t)+5*cos(2*pi*65*t);
signal2=cos(2*pi*5*n*ts)+cos(2*pi*65*n*ts);
subplot(211)
plot(t,signal)
subplot(212)
plot(n,signal2)
y=fft(signal);
figure
plot(abs(y))
```

b- What are the methods to reconstruct an analog signal from its discrete form? Explain briefly. (1 marks)

c- The signal x is a discrete time signal with length 2000 sample, determine the number of addition and multiplication needed to convert the signal to the frequency domain when using:

i. DFT

ii. FFT

(1 marks)

d- Write MATLAB instructions to find the inverse z-transform of the following signal using the partial fraction method: (2 marks)

\[ X(z) = \frac{1 + 4z^{-1} + 2z^{-2}}{1 + 0.7z^{-2}} \]
e- Design LabVIEW VI to add echo effect to the music file “tone.wav” found in the path: D:\DSP, with the following specifications: Delay=0.4 sec, Gain=0.7. (2 marks)

f- You have the function ideal_freq on your work space, design an FIR filter with the following specification:
   Stop band edge: 0.7π
   Pass band edge: 0.55π
   Attenuation in the stop region: 60 dB
   Ripple in the pass region: 0.15 dB (2 marks)

<table>
<thead>
<tr>
<th>Window Name</th>
<th>Transition Width $\Delta \omega$</th>
<th>Min. Stopband Attenuation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Approximate</td>
<td>Exact Values</td>
</tr>
<tr>
<td>Rectangular</td>
<td>$4\pi / M$</td>
<td>$1.8\pi / M$</td>
</tr>
<tr>
<td>Bartlett</td>
<td>$8\pi / M$</td>
<td>$6.1\pi / M$</td>
</tr>
<tr>
<td>Hanning</td>
<td>$8\pi / M$</td>
<td>$6.2\pi / M$</td>
</tr>
<tr>
<td>Hanning</td>
<td>$8\pi / M$</td>
<td>$6.6\pi / M$</td>
</tr>
<tr>
<td>Blackman</td>
<td>$12\pi / M$</td>
<td>$11\pi / M$</td>
</tr>
</tbody>
</table>

Table 1. Summary of commonly used window function characteristics

B) Fill in the blanks:
   a. ........ is the most widely used LAN technology.
   b. The data link layer of Ethernet consists of the .... sublayer and the .... sublayer.
   c. Each station on Ethernet network has unique .... bit address imprinted in its NIC.
   d. Line coding is the process of .................

Q2] A) Answer the following:
   a. What is the difference between unicast, Multicast, and broadcast address? Write a unicast address, multicast address, and the broadcast address for data link control layer.
   b. What is the advantage of dividing the Ethernet LAN with a bridge?
   c. What is CSMA/CD? Is it needed in half-duplex or full-duplex LAN? Why?
   d. State three IEEE LAN technologies. Mention the IEEE standard for each.

B) What is Modem? Mention three Modem standards. Explain one of them. Draw a diagram showing how a Modem is used in data communication.

Q3] A) The diagram shows frames transfer between two nodes. Answer the following:
   a. What is the function being performed?
   b. What is the type of this function?
   c. Explain how this type of function is carried out?
B) What is flow control? What is the purpose of this control. What are the types of protocols for the flow control. Explain with diagrams.

Q4) A) Explain the functions of the Router in computer networks.

B) Refer to the figure below, answer the following:

a. How many LANs and WANs?
b. Mention and assign the type of each interface in the diagram.
c. Assign network IP address for each LAN and WAN.
d. Assign IP address for each host.
e. What is the default gateway IP address for each LAN.
f. The diagram represents Internet, internet, or internetwork?
g. How many collision domains and broadcast domains?
h. Mention the OSI layers related to the operation of the Router.

Q5) A) What are the Fast Ethernet implementations? Explain each one and draw the encoding method.

B) What are the Gigabit Ethernet implementations? Fill in the table for each one.

<table>
<thead>
<tr>
<th>Implementation</th>
<th>Characteristic</th>
<th>Media</th>
<th>Number of wires</th>
<th>Maximum length</th>
<th>Block coding</th>
<th>Line encoding</th>
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<tr>
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</table>
عرف خمساً من المصطلحات التالية:
الدولة البسيطة / الحكومة الاستبدادية / الحكومة الفردية (المونوقراطية) / الديمقراطية المباشرة / الحكم الشعبي للبرلمان / أسلوب الاقتراع العام

(20 درجة)

اجب عن فرعين مما يأتي:
أ/ ذكر محاكاة ومساواة الحكم الجمهوري؟ (10 درجات)
ب/ ما هي أنواع النظام النيابي؟ (10 درجات)
ج/ بعد الاستفتاء الشعبي واحد مظاهر أو وسائل الديمقراطية شبه المباشرة أشرح ذلك؟
(10 درجات)

من ضمن صور النظام الانتخابية نظام الانتخاب الفردية والانتخاب بالقائمة تكلم عنها بالتفصيل مع ذكر مزاياها وعيوبها؟
(20 درجات)

مع دعائنا لكم بالنجاح والموفقة

مدرسة المادة

محمد طاهر قاسم الإوجه
Q1) Evaluate the integrals

1. \( \int \frac{xy}{\sqrt{x^2 + y^2}} \, dx \, dy \), where \( R \) is a triangle bonded by \( x \)-axis, the lines \( x=1 \) and \( x=y \).

2. \( \int \frac{2z + 1}{z^2 + z^2} \, dz \) where \( C \) is \( |z + 1| = 1 \)

Q2) Apply the Euler method to the following initial value problem. Do 10 steps with \( h=0.1 \). Solve the problem exactly and compute the errors.

\[ y' + 5x^4 \, y^2 = 0 \] \( y(0) = 1 \)

Q3) Let

\[ A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 5 & 0 \\ 2 & 0 & 7 \end{bmatrix} \]

1. Is \( A \) a symmetric matrix?

2. Find the Eigen values and associated eigenvectors of the matrix and check that \( P^{-1}AP = D(\lambda_1, \lambda_2, \lambda_3) \), where \( P \) is eigenvectors of the matrix.

3. Compute \( \sin(A) \).

Q4) A- Determine if the plane given by \(-x + 2z = 10\) and the line given by \( \vec{r} = 5i + (2-t)j + (10+4t)k \) are orthogonal, parallel or neither. [5 marks]

B- Evaluate \( \int_{0}^{1} x^3 J_0(x) \, dx \) using \( J_1(2) = 0.5767 \) and \( J_1(1) = 0.4401 \). [5 marks]

Q5) A- Find the particular solution of \( \frac{d^2 y}{dx^2} - 5 \frac{dy}{dx} = x e^{5x} \) by the method of undetermined coefficients. [5 marks]

B- Find the product solution of \( 3 \frac{\partial u}{\partial y} + \frac{\partial^2 u}{\partial x \partial y} = 0 \) [5 marks]

Q6) The probability that a person suffer a bad reaction from a given serum is 0.001, determine the probability that out of 2000 persons

1. exactly 3 persons;
2. more than 2 persons;
3. at most 3 persons;
4. from 1 to 4 persons will suffer a bad reaction.
5. Find the mean and variance of the number of person suffer a bad reaction. [10 marks]
س 1: أ) قيّمتهما في الشكل وباستخدام الثوابت الهجينية (hfe = 100, hib = 10 Ω)

1. حساب كسب الفولتية الإجمالي للدائرة.
2. جد قيمة Vcc التي تجعل نقطة تشغيل (Q Point) في منتصف خط الحمل ثم حسب قيمة Rb.
3. جد عامل الاستقرار S1co.

(8 درجات)

ب) أرسم خواص الثائرستور وبين متي يتحول من حالة (On) إلى حالة (Off). (4 درجات)

س 2: أ) قيّمتهما في الشكل أوجد ما يلي:

1. كسب الفولتية الإجمالي عند تردد القطع.
2. كسب الفولتية الإجمالي عند التردد (10Hz).

علما أن:
C1 = 10 μF
C2 = 1 μF

(4 درجات)

ب) ما هو سبب وجود ترددات القطع في مكبرات الإشارة؟. (4 درجات)
ب) ارسم خواص ترانستور تأثير المجال من النوع التعزيزي وبين حدود عمله كمكبر للإشارة.
(4 درجات)

س٤) اصمم دائرة Practical Differentiator (قادرة على إجراء مشتقة فولتية إدخال 1 cos 314t) كما أن الدائرة تقوم بتكميم إشارة الإدخال بكسب قدره 0.01 μF . (افترض قيمة Av = 0.5)
(3 درجات)

ج) ارسم الدائرة المكافئة لتراستور أحادي الوصلة (UJT).
(3 درجات)

(12 درجة)

س٥: في الدائرة المبينة، ارسم شكل فولتية الإخراج.

(12 درجة)


d_5r

تمنياى بالنجاح - مدرس المادة
ANSWER ALL QUESTIONS

Q1)
A. What are the contents of the memory after execution the following piece of code:

```assembly
mov ax, 8000h
mov es, ax
mov cx, 10
mov di, 2000h
rep stosb
mov cx, 10
dec di
next: NEG byte ptr es:[di]
loop next
```

[5 Marks]

B. Write a piece of code to compute:

\[ Z[i] = \frac{X[i] + Y[i] + Y[i]}{Z[i] + 30h} \]

Where:

\( i = 0, 1, 2, \ldots, 1023 \)

\( X \) : 8bit signed integer array of size 1Kbytes

\( Y \) : 8bit signed integer array of size 1Kbytes

\( Z \) : 8bit signed integer array of size 1Kbytes

[5 Marks]

Q2)
A. \( X \) is a square matrix of size 32 X 32 (8-bit signed integer) stored in computer memory as row major. Write a piece of code to exchange the last row with the main diagonal elements of \( X \) matrix.

[6 Marks]

B. Design the hardware required for demultiplexing and fully buffering the 8086 buses in minimum mode operation.

[4 Marks]
Q3) Write a piece of code to compute:

\[ Y(n) = 1.2 \times X(n) + 0.75 \times X(n-1) \times 0.915 \times Y(n-2) \]

Where:

- \( n = 0, 1, 2, \ldots, 199 \)
- \( X \) : is a 16-bit signed integer array of size 200.
- \( Y \) : is a 16-bit signed integer array of size 200.

**Note:** \( X(-1) \), \( Y(-1) \) and \( Y(-2) \) are zeros. Use fixed point arithmetic with 5-bit fraction.

Q4)

Design the hardware required for interfacing the 8086 demultiplexed buses to the following system memory:

1. 64 Kbyte of ROM using 16 Kx8 ROM chips starting at address F0000h.
2. 128 Kbyte of SRAM using 64 Kx8 SRAM chips starting at address 00000h.

Q5)

A. Write an assembly subroutine to print the value of BX register (unsigned) in decimal. Use the following declaration:

```assembly
PrintDec PROC
PrintDec ENDP
```

B. Compute the time delay generated by the following subroutine:

```assembly
Delay PROC
    PUSH CX
    MOV CX,100
    MOV AX, CX
    NEXT : PUSH AX
            POP CX
            LOOP NEXT
    POP CX
    RET
Delay ENDP
```

Given the following: 8086 speed is 5MHz, call 19T, ret 16T, mov reg, data 4T, push reg 11T, pop reg 8T, loop 17/5 T.
Q1: (12 Marks)
The four binary/five binary (4B/5B) coding used in digital signal, the data sequence encoded shown in the Table (1)
- Design use PLA to implement the Encoded Sequence (6 Marks)
- Design use suitable ROM (6 Marks)

Q2: (12 Marks)
The ASM chart of pulse mode of a brake control system is shown in Figure (2). Draw state diagram and design the system.

Q3: (12 Marks)
The combinational logic circuit shown in Figure (3)
- Implement the function with minimal NAND gates by use map entered variables method when (B, and C) are entered variables. (6 Marks)
- Redesign use type 2 MUX (A, and D) are partitioned variables. (6 Marks)

Q4: (12 Marks)
Analyze the circuit shown in Figure (4) and draw the state diagram

Q5: (12 Marks)
Using Quine-McCluskey method, obtain all the prime implicants and essential prime implicants for the following Boolean function:
\[ F(A,B,C,D,E) = \sum m(0,5,7,11,12,14, 21,28,30,31)+d(3,13,22,23) \]
Implement the function with hazard free use NAND gates only, and design with the following signal:
Signal list : ~F, A[NL], ~B, C, ~D[NL], ~E
Table 1

<table>
<thead>
<tr>
<th>Data Sequence</th>
<th>Encoded Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>11110</td>
</tr>
<tr>
<td>0001</td>
<td>01001</td>
</tr>
<tr>
<td>0010</td>
<td>10100</td>
</tr>
<tr>
<td>0011</td>
<td>10101</td>
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<td>0100</td>
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<tr>
<td>1110</td>
<td>11100</td>
</tr>
<tr>
<td>1111</td>
<td>11101</td>
</tr>
</tbody>
</table>

Figure (2)

Figure (3)

Figure (4)

(2 - 2)
Attempt All questions

Q1- A linear system with input $x(t)$ and output $y(t)$ is modeled by the differential equation:
$$\frac{d^2 y(t)}{dt^2} + 2\frac{dy(t)}{dt} + 4y(t) = \frac{dx(t)}{dt}$$

a- Determine the Frequency Response of the system, $H(\omega)$.
b- Compute $|H(\omega)|$ and sketch its graph.
c- Determine the output to $x(t) = 5 \sin(3t)$.


Q3- Sketch single side and double side spectra of the signal $x(t) = 1 + \cos(2\pi t) + e^{jnt}$.

Q4- a- Find the inverse Laplace transform of $H(s) = \frac{e^{-2t}}{(s^2 + 3s + 4)}$.
b- Write the differential equation of the system that $H(s)$ in (a) represents its transfer function.
Q5) Complete the following MATLAB program that implements the signals shown below.

```matlab
% MATLAB program

% Define time vector
t1 = -7:.01:-4;
y1 = -5.5 + abs(8 * sinc(pi/11*t1));
t2 = -4:.01:0;
y2 = -5 + (cos(pi/4*t2+2));
```

Q6) Design the following differential equation by SIMULINK.

\[ y''' = 8u(t) + 3 - 4t + 3y'' - 7y \]

Q7) Given the following array \( a = \begin{bmatrix} 2.8 & 5 & 3.5; & -8.6 & 3 & 4.4; & 3.8 & 2.9 & -.9 \end{bmatrix} \), what are the results of the following commands:

1- >> a(end,1:2:end)
2- >> m = floor(-1*ones(3,4)-.25)
3- >> d = (diag(3:-1:-4))
4- >> e = [zeros(2,3);a; 0.5*ones(1,3)]
5- >> sum(diag(a))
Q1: The Ministry of Higher Education and Scientific Research has decided to give an award to the graduated students who graduated in 2013 of all Engineering colleges with average over 90. Write C++ program that can read the students' database from a text file called "Students_Database.txt" with 100000 records of the structure "Students". Then create a linked list that can find all the students with the given information above. Finally, Store the linked list in a binary file called Chosen_Std.bin.

```
struct Students{
    char Name[20];
    Date grad;
    char University[10];
    char College[10];
    float Avg;
    Students *Next;
};
struct Date{
    int Year;
    int Month;
    int Day;
};
```

[10 marks]

Q2: Write C++ program that can store 5 points in Cartesian coordinates of the structure Cartesian in a Queue.

```
struct Cartesian{
    float x,y;
};
```

Then convert these points to Polar coordinates and print them on the screen.

[10 marks]
Q3: Self-checkout machines provide a mechanism for customers to pay for purchases from a shop without direct input to the process by the shop's staff. Create a class called Checkout for performing checkout service in a shopping mall. Use char variable to represent the item, unsigned long to represent the barcode, float variables to represent the price and the weight as private data of the class. Provide a constructor that enables an object of this class to be initialized when it’s declared. Provide public methods that perform each of the following tasks:

a. The operator & for printing the item, barcode, price and weight.

b. A friend function called get_price. This function would return the price when you provide it with an object and a barcode. This function should return -1 if the object’s barcode doesn’t match the input barcode.

c. A friend function called get_price. This function would return the price when you provide it with an object and an item name. This function should return -1 if the object’s item-name doesn’t match the input item’s name.

Define the following array of objects as a database in your main.

```cpp
checkout a[3]=
{checkout("Sugar",12345,1000,1), checkout("Rice",13450,2000,2),
checkout("Oil",13456,3000,1)};
```

Use get_price function to return the price of the barcode (13450) and the item “Sugar” then print the results.

[ 10 marks]

Q4: Write C++ program that can find and print the cities that their temperature is over 50 and the first letter of the city’s name is ‘B’ of the array Iraq. Then store your result in a Stack. Finally, calculate the average temperature in Iraq.

The structure is:

```cpp
struct Forecast { char city[10]; int temp; };
“Basrah”,54,NULL, “Diala”,48,NULL};
```

[ 10 marks]

Q5: What is the execution result of running the following C++ program? Comment on you result.

```cpp
#include <stdio.h>
int linear(int a[], int n, int target)
{
if (n<0) return -1;
else if (target==a[n-1]) return (n-1);
else return (linear(a,n-1,target));
}
```
int partition (int a[], int first, int last)
{
    int pivot = first;
    for (int i = first + 1; i <= last; i++)
        if (a[i] > a[first])
            { 
                pivot++;
                int temp = a[pivot];
                a[pivot] = a[i];
                a[i] = temp;
            }
    int temp = a[pivot];
    a[pivot] = a[first];
    a[first] = temp;
    return (pivot);
}
void sort (int a[], int first, int last)
{
    if (last < first) return;
    int split = partition(a, first, last);
    sort(a, first, split - 1);
    sort(a, split + 1, last);
}
void main()
{
    int a[10] = {33, 10, 130, 2, 4, 20, 51, 11, 83, 77};
    sort(a, 0, 5);
    printf("The array after sorting\n");
    for (int j = 0; j < 10; j++) printf("%d \t", a[j]);
    for (int k = 0; k < 2; k++)
        { 
            int t = a[k + 6];
            a[k + 6] = a[9 - k];
            a[9 - k] = t;
        }
    printf("The array after the editing\n");
    for (int j = 0; j < 10; j++) printf("%d \t", a[j]);
    int i = linear(a, 10, 51);
    printf("\nindex=%d\n", i);
}

[ 10 marks]
Question 1 // (12 points)
At the input of a (Balanced modulator) there are the following modulating voltage signal:
\[ m(t) = 0.8 \cos(40 \pi t^3) \text{ and carrier voltage signal: } C(t) = \cos(4 \pi t^5) \].

- Draw its block diagram of the (Balanced modulator);
- Derive the output voltage equation of the (Balanced modulator) \( S(t) \);
- Find the Modulation index; the upper and lower sideband frequencies \( f_{ub} \), \( f_{lb} \); the carrier power \( P_c \); the total power output \( P_T \); and the double- side-band power \( P_{dsb} \) of Modulator.

Question 2 // (12 points)
Given the following waveform of a modulated signal at the output of a modulator; find:
- the type of this modulator
- the expected message signal equation at the input of this modulator with all values \([m(t)]\).
- the expected voltage amplitude of the carrier signal at the input of this modulator \([E_c]\).
- the expected frequency of the carrier signal at the input of this modulator \([f_c]\).
- the instantaneous voltage equation of the carrier signal at the input of this modulator \([C(t)]\).
- the expected output signal equation at the output of this modulator with all values \([S(t)]\).

Question 3 // (12 points)
For DSB-LC Amplitude Modulation, the mean square value of the noise power in a specified bandwidth is given by:
\[ N_t = 4 n_a f_m^2 \]
Prove that the signal to noise power ratio at the output of the detector is twice that at the input of the detector in the receiver:
\[ S_0 / N_0 = 2 [S_1 / N_1] \].

Question 4 // (12 points)
Using the given \((V_D)\) and \((I_D)\) equations at any point \((D)\) on the transmission line, of propagation constant \((y)\), at a distance \((X)\) from the sending end and at a distance \((d)\) from the receiving end of the line, Derive the following reflection coefficient factor equation \([k_D(v)]\) at point \((D)\).
\[ k_D(v) = k_R \cdot e^{-2\pi d} \text{; Where: } V_D = A \cdot e^{-\gamma X} + B \cdot e^{+\gamma X} \]
\[ k_R(v) = (Z_R - Z_\alpha) / (Z_R + Z_\alpha) \text{; I}_D = (A \cdot e^{-\gamma X} - B \cdot e^{+\gamma X}) \cdot (1 / Z_\alpha) \]
Question 5 // (12 points)

For the given Loss-free transmission line:
- Find the VSWR of T.L.;
- Find the admittance \( Y_R \) of the load;
- How far is the first minimum voltage point from \( Z_R \);
- How far is the first maximum voltage point from \( Z_R \);
- Find the input impedance \( Z_s \) at the sending of T.L.;
- Find the reflection coefficient factor at the receiving end \( K_R = \frac{Z_R - Z_0}{Z_R + Z_0} \);
- Find the reflection coefficient factor at the sending end \( K_S = \frac{Z_S - Z_0}{Z_S + Z_0} \);
- Find the value of the equivalent input impedance at the first minimum voltage point;

Question 6 // (12 points)

A Wide-Band Frequency Modulator has a resonance circuit of an inductor \( L = 10 \mu \text{H} \), and an initial capacitor is \( C_0 = 1000 \text{ pF} \) (Without modulation signal); the variable capacitor’s sensitivity to voltage change will be \( k_c = 5.03145 \text{ pF}/\text{volts} \) (When the modulating signal is applied to the modulator).

If the modulating signal is \( m(t) = 0.5 \cos(2\pi 10^3 t) \):
- Find The carrier frequency and modulating frequency of this modulator;
- Find The Frequency Sensitivity (\( k_f = ? \text{ Hz/v} \)) of this modulator; and
- Find The Maximum frequency deviation (\( \Delta f \));
- Find The Modulation index (\( m_f \));
- Find The required Bandwidth;
- Find The instantaneous frequency equation \( f_i(t) \) of this modulator;
- Given that the carrier power is (2.42 watts) for \( (R = 1 \Omega) \), Find the total power.
- State the general carrier voltage equation \( C(t) \) of this modulator.

Table of Bessel functions

<table>
<thead>
<tr>
<th>( m_f )</th>
<th>( J_0 )</th>
<th>( J_1 )</th>
<th>( J_2 )</th>
<th>( J_3 )</th>
<th>( J_4 )</th>
<th>( J_5 )</th>
<th>( J_6 )</th>
<th>( J_7 )</th>
<th>( J_8 )</th>
<th>( J_9 )</th>
<th>( J_{10} )</th>
<th>( J_{11} )</th>
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<tr>
<td>0.00</td>
<td>1.00</td>
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<td>-0.10</td>
<td>0.19</td>
<td>0.34</td>
<td>0.32</td>
<td>0.22</td>
<td>0.13</td>
<td>0.06</td>
<td>0.03</td>
</tr>
</tbody>
</table>
ATEEMPT ALL QUESTIONS

Electronics Lab

Q1) Choose the correct answer:   [7.5 Marks]

1. For transistor, which is wrong among the following descriptions?
   a) Transistor is a bipolar device.
   b) Transistor is a voltage-control device.
   c) Transistor is a current-control device.

2. The dc load line intersects the $I_c$ axis at
   a) $V_{CE} = V_{CC}$
   b) $I_c = V_{CC}/R_c$
   c) $I_c = V_{BE}$

3. Among all configurations of the transistor amplifiers, which one has the largest power gain?
   a) CE configuration
   b) CC configuration
   c) CB configuration

4. When the transistor works as a switch, it represents:
   a) Amplifier
   b) NOT Gate
   c) Buffer

5. If base-emitter junction is open in the common collector transistor, the collector voltage is:
   a) $V_{CC}$
   b) 0V
   c) Floating

6. If you had two transistors each one with a current gain $= 50$, then the total current gain $\beta_{eq}$ equals to:
   a) 100
   b) 2500
   c) 1
7. For Darlington pair, which is wrong among the following descriptions?
   a) Current gain is very high.
   b) Input impedance is very large.
   c) High voltage gain

8. For JFET transistor, at what condition does the cut-off occur?
   a) The cut-off voltage occurs at \( V_p = -V_{DS} \)
   b) The cut-off voltage occurs at \( V_p = -V_{GS} \)
   c) The cut-off voltage occurs at \( V_p = -V_{CC} \)

9. The symbol for transconductance in JFET is
   a) \( \beta \)
   b) \( \alpha \)
   c) \( g_{m} \)

10. For a JFET common drain amplifier, the output is taken from:
    a) Source
    b) Drain
    c) Gate

Q2)

A. What are the advantages of relay?  [2 Marks]

B. Prove that the voltage gain in common-drain JFET amplifier \( \approx 1 \).  [1.5 Marks]

Q3)  [4 Marks]

Compare between Common Emitter and Common Collector amplifier from the sides of Voltage gain, current gain, output resistance and phase difference.

<table>
<thead>
<tr>
<th></th>
<th>Common Emitter</th>
<th>Common Collector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Gain, ( A_V )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Gain, ( A_I )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Resistance, ( R_o )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase difference</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Loeic Lab.

Q4) Draw the logic circuit for the Master-Slave JK Flip-Flop using Nand gates only then verify its truth table. [7 Marks]

Q5) [8 Marks]

A. Draw the logic circuit diagram, which will result from the execution of the following VHDL code, then describe its behavior and give its Boolean function.

```vhdl
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_ARITH.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;

-- Uncomment the following library declaration if instantiating any Xilinx primitives in this code.
--library UNISIM;
--use UNISIM.VComponents.all;

entity BooleanFx is
    Port ( A : in STD_LOGIC_VECTOR (3 downto 0);
          F : out STD_LOGIC);
end BooleanFx;

architecture Behavioral of BooleanFx is
begin
    signal s1,s2,s3,s4: STD_LOGIC;

    with A(1 downto 0) select
        s1<='0' when "00",
            '0' when "01",
            '0' when "10",
            '1' when OTHERS;

    with A(1 downto 0) select
        s2<='1' when "00",
            '0' when "01",
            '1' when "10",
            '0' when OTHERS;
```

```
```
with A(1 downto 0) select
s3<= '0' when "00",
  '1' when "01",
  '1' when "10",
  '0' when OTHERS;
with A(1 downto 0) select
s4<= '0' when "00",
  '0' when "01",
  '1' when "10",
  '1' when OTHERS;

with A(3 downto 2) select
F<= s1 when "00",
  s2 when "01",
  s3 when "10",
  s4 when OTHERS;
end Behavioral;

B. Write a complete VHDL program to implement the pseudo random generator, which is shown in the figure bellow.

Good Luck
Q1 – What are Hooker’s core principles? Explain three of them. [12 marks]

Q2 - Every communication meeting with the customer should have a leader. What will be discussed in the meeting? What should the leader do? List the communication principles and concepts as they apply to customer communication. [12 marks]

Q3 – Extreme programming is the most widely used agile process. Explain what will be done in the planning stage. [12 marks]

Q4 - Consider two fuzzy sets A and B. Let the universe of discourse be comprised of discrete units { 2, 3, 4, 5, 6}. Find \( \tilde{A} \), \( \tilde{B} \), \( A \cup B \), \( A \cap B \).

A = \{ \frac{1}{2}, \frac{0.5}{3}, \frac{0.6}{4}, \frac{0.2}{5}, \frac{0.6}{6} \}

B = \{ \frac{0.5}{2}, \frac{0.8}{3}, \frac{0.4}{4}, \frac{0.7}{5}, \frac{0.3}{6} \}

[8 marks]

Q5 – Consider the following network consists of four inputs with the weights as shown:

\[ X_1 = 1 \rightarrow -1 \]
\[ X_2 = 2 \rightarrow -1 \]
\[ X_3 = 5 \rightarrow -1 \]
\[ X_4 = 8 \rightarrow -2 \]

\[ \sum \rightarrow Y \]

Calculate the value of R and Y for binary activation function? [8 marks]
Q6 - If you have four individuals:

<table>
<thead>
<tr>
<th>P1</th>
<th>1010 1110 1000 0011</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>0110 1001 1111 0110</td>
</tr>
<tr>
<td>P3</td>
<td>0111 0110 1110 1011</td>
</tr>
<tr>
<td>P4</td>
<td>0001 0110 1000 0000</td>
</tr>
</tbody>
</table>

The first and third individuals are chosen for cross-over. The fourth and fourteenth bits are randomly selected for the cross-over points. Write the next generation individuals.

[8 marks]

~~ GOOD LUCK ~~
Q1 (A) - Consider the image segment shown. Let $V = \{0, 1\}$ and compute the lengths of the shortest 4- and m-path between p and q. If a particular path does not exist between these two points, explain why.

\[
\begin{array}{cccc}
p & 0 & 0 & 2 \\
0 & 4 & 6 & 1 \\
6 & 0 & 1 & 3 \\
6 & 1 & q & 4
\end{array}
\]

(4 marks)

Q1 (B) - In the first row below you there is an image with its corresponding histogram. Three different look-up tables (a-c) have been used to transform the image and the resulting histograms after transformation are shown (I-III). Combine each histogram (I-III) with the corresponding LUT (a-c). Briefly justify your choice.

(6 marks)

Q2

a) How does the “salt & pepper” noise look like? How can it be removed? (2 marks)

b) What is the difference between the spatial resolution and the gray level resolution? (2 marks)

c) Discuss how can I get a sharpened image where edges and fine detail are much more obvious, with example? (3 marks)

d) Briefly explain the problem of ringing in the frequency domain filtering? (2 marks)

e) Describe one method that finds lines/edges at certain directions in an image. (3 marks)

f) Degradation function is an important for image restoration, state the methods of degradation function estimation and explain one of them. (3 marks)
Q3 (A) - Images shown below have size $80 \times 40$ pixels, with black (0) and white (1). The white box in the image is $20 \times 20$ pixels. What would this image look like after application of? (6 marks)

- a- A $5 \times 5$ arithmetic mean filter?
- b- A $5 \times 5$ max filter?
- c- A $5 \times 5$ min filter?
- d- A $5 \times 5$ midpoint filter?

Note: answer three only.

Q3 (B) - The first row below shows an image (original) and its corresponding frequency domain. The row in the middle displays different frequency domain filters (F1-F4). The third row shows the resulted image (I1-I4). Combine each image (I1-I4) with its corresponding frequency domain (F1-F4). (4 marks)

<table>
<thead>
<tr>
<th>Original</th>
<th>FFT(Original)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Original Image" /></td>
<td><img src="image2.png" alt="FFT Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="F1 Image" /></td>
<td><img src="image4.png" alt="F2 Image" /></td>
<td><img src="image5.png" alt="F3 Image" /></td>
<td><img src="image6.png" alt="F4 Image" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>I1</th>
<th>I2</th>
<th>I3</th>
<th>I4</th>
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<tbody>
<tr>
<td><img src="image7.png" alt="I1 Image" /></td>
<td><img src="image8.png" alt="I2 Image" /></td>
<td><img src="image9.png" alt="I3 Image" /></td>
<td><img src="image10.png" alt="I4 Image" /></td>
</tr>
</tbody>
</table>
Q1 (A) - Consider the image segment shown. Let \( V = \{0, 1\} \) and compute the lengths of the shortest 4- and \( m \)-path between \( p \) and \( q \). If a particular path does not exist between these two points, explain why.

\[
\begin{array}{cccc}
p & 0 & 0 & 2 \\
0 & 4 & 6 & 1 \\
6 & 0 & 1 & 3 \\
6 & 1 & q & 4 \\
\end{array}
\]

(4 marks)

Q1 (B) - In the first row below you there is an image with its corresponding histogram. Three different look-up tables (a-c) have been used to transform the image and the resulting histograms after transformation are shown (I-III). Combine each histogram (I-III) with the corresponding LUT (a-c). Briefly justify your choice.

(6 marks)

Q2
a) How the “salt & pepper” noise look like? How can be removed? (2 marks)

b) What is the difference between the spatial resolution and the gray level resolution? (2 marks)

c) Discuss how can I get a sharpened image edges and fine detail are much more obvious, with example? (3 marks)

d) Briefly explain the problem of ringing in the frequency domain filtering? (2 marks)

e) Describe one method that finds lines/edges at certain directions in an image. (3 marks)

f) Degradation function is an important for image restoration, state the methods of degradation function estimation and explain one of them. (3 marks)
1. Answer each of the following:
   (A) Explain the advantages of current signals over voltage signals transmission.
   (B) Explain scheduling decision point of a task scheduling algorithm? How the scheduling decision points are determined in (i) clock-driven, (ii) event-driven schedulers?
   (C) State whether the following statements are TRUE or FALSE. Justify your answer.
      (i) The sensitivity of the Wheatstone bridge circuit may be increased by employing only one active element.
      (ii) In order to minimize the loading effect of the potentiometer, the signal conditioning circuitry should have high input impedance.
      (iii) In the potentiometer, electrical loading error can be significant when load resistance is low.
      (iv) For the capacitive sensors, the variations in dielectric properties due to humidity, temperature, and pressure can cause errors which can be compensated using capacitive bridge circuit.
      (v) Scheduling decisions are made only at the arrival and completion of tasks in a non-preemptive event-driven task scheduler.

2. (A) Using a cyclic real-time scheduler,
   (i) Suggest a suitable frame size that can be used to schedule three periodic tasks T1, T2, and T3 with the following characteristics:

<table>
<thead>
<tr>
<th>Task</th>
<th>Phase (ms)</th>
<th>Execution Time (ms)</th>
<th>Relative Deadline (ms)</th>
<th>Period (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>0</td>
<td>20</td>
<td>100</td>
<td>100</td>
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<tr>
<td>T2</td>
<td>0</td>
<td>20</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>T3</td>
<td>0</td>
<td>30</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

   Note: LCM (100, 80, 150)=1200
   (ii) It is possible that more than one frame size satisfies all the constraints of the structured cyclic scheduler. Why is it preferable to choose the shortest frame size?

   (B) Consider the following system of periodic tasks:
      T1=(100, 20), T2=(150, 50), and T3=(250, 100)
   Construct the initial segments in the time interval (0, 750) of Earliest-Deadline-First (EDF) schedule.

3. Answer two of the following:
   (A) An electrical resistance strain gauge has a resistance of 120 \( \Omega \) and a gauge factor of 2.1. What will be the change in resistance of the gauge when it experiences strain of 0.0005 along its length?
   (B) A differential amplifier is to be used to amplify the voltage produced between the two junctions of a thermocouple. The input resistances are to be 1 k\( \Omega \). What value of feedback resistance is required if there is to be an output of 10 mV for a temperature difference between the thermocouple junctions of 100 °C with a copper-constantan thermocouple. The thermocouple can be assumed to give an output of 43 \( \mu \)V/°C.
(C) For the capacitive transverse displacement sensor shown below. Determine the sensor sensitivity. Then, suggest a circuit that can be used to linearize the sensor relationship.

![Capacitive Transverse Displacement Sensor Diagram]

4.

(A) Choose the correct answer

1. This program code will be executed once:
   
   STAT: MOV A, #01H
   JNZ STAT
   A. True  
   B. False

2. The 8051 can handle _______ interrupt sources.
   
   A. 3  
   B. 4  
   C. 5  
   D. 6

3. The following program will receive data from port 1, determine whether bit 2 is high, and then send the number FFH to port 3:
   
   READ: MOV A, P1
   ANL A,#2H
   CJNE A,#02H, READ
   MOV P3, #FFH
   A. True  
   B. False

4. The total external data memory that can be interfaced to the 8051 is:
   
   A. 32K  
   B. 64K  
   C. 128K  
   D. 256K

(B) Write an assembly language program using Timer 0 only and interrupts to simultaneously generate 5 KHz and 2.5 KHz square waves on (P1.7 and P1.6), respectively.

5. A digital clock is to be designed using 8051 Microcontroller, four 7-segment display devices (two for Minutes digits and two for hours digits) and four BCD to 7-segment decoder ICs (74LS47).

   (A) With the aid of a block diagram describe the 8051 based hardware circuit for this system.

   (B) For your design in above, write an 8051 assembly level program to implement this digital clock.

   Note: in order to reduce the design complexity, assume that the initial values for the minutes and hours digits are 00:00.
Question One (Attempt only Four, Each carries 5 Marks)  (20 Marks)

i- Compare between business process reengineering and continuous improvement system?

ii- What is the relationship between data and information? What are the characteristics of valuable data?

iii- What are primary responsibilities in information systems of the following IS titles; CIO, LAN administrator, operations, supports and system development?

iv- System design has two dimensions: logical and physical design, define each form of design and show what each type of design involves?

v- How systems design is evaluated? What are the evaluation techniques?

Question Two (Attempt only Four, Each carries 5 Marks)  (20 Marks)

i- What the system security and controls design involves?

ii- What are the typical steps in systems implementation? With the aid of diagram show the sequence of these steps.

iii- Briefly describe the main types of test on the implemented information system?

iv- Define the term systems review. Compare between event and time driven system review. What are factors to consider during systems review?

v- What are the factors affecting systems development success?

Question Three (Attempt only Four, Each carries 5 Marks)  (20 Marks)

i- Compare between datamart and data warehouse? What are the relation between data warehouse and data mining?

ii- Discriminate between traditional and database approach. What are the advantages of database approach?

iii- Show how a database management system can be selected?

iv- What are the main classification and types of computer systems. What are the parameters need to be considered in the selection and upgrading computer systems?

v- Discriminate between Internet, Intranet and Extranet?

Question Four  (Each carries 10 Marks)  (20 Marks)

i- Define the term Information system planning and its relation to organization goals. With the aid of diagram show the main steps of IS planning.
ii- What are the main types of SDLC? With the aid of diagram show the sequence of steps in traditional type. Briefly describe each step in the traditional type of SDLC. Clarify your answer with diagram showing traditional type steps.

**Question Five** *(20 Marks)*

Define the term Computer-based information system (CBIS)? Briefly describe five most common types of information systems used in business organizations?
Note: Answer all questions

Q1 [10 Marks] Answer the following:

a. What is CSMA/CD? Draw a flow diagram for this procedure. Is it needed in half-duplex or in full-duplex transmission? Why?
b. Discuss the number of bands per medium bandwidth for TDMA, FDMA, and CDMA.
c. Explain why most of the addresses in class A are wasted. Explain why medium-sized or large-sized corporation does not want a block of class C addresses.
d. A router receives an IPv4 packet with source IP address 130.45.3.3 and destination IP address 201.23.4.6. The router cannot find the destination IP address in its routing table. Which ICMPv4 message should be sent?
e. Mention three IPv4-to-Ipv6 transition mechanisms. Explain one of them.

Q2 [10 Marks] A) In CDMA system with four stations, the demultiplexer (at receiving end) receives the following sequence across the link: (-1, -1, -3, +1). Show what will each station receive at the output of the demultiplexer.

B) Draw the message format for ICMP. Explain the function of each field. Mention the two broad types of ICMP messages. Categorize each one.

Q3 [15 Marks] A) Define the BOOTP. Explain with diagrams how the BOOTP is functioning on the same and on different networks.

B) Explain with a diagram the ARP proxy function.

Q4 Lab questions [15 Marks]

A) Java Programming:

a. What is the difference between Overloading and Overriding? Give example for both of them.

b. Write the suitable code for designing security code used in many websites. This code consists of four digits, two digits for random capital letters from (A-Z) and the other two for random numbers from (1-10). Note that ASCII for A to Z are (65-90).
B) Networks Lab

a. In the topology shown in Figure below, if ITS1 send MAC address request to ITS5 and another request to ITS6. Is there any response from ITS5 & ITS6? Justify your answer whether Yes or No. (2.5 Marks)

b. How does the destination device know that the response of MAC address is from Format 1 or Format 2 Type? (2 Marks)

c. Describe the purpose for the following buttons in ITS XClient program: Listening On, M Br, Snd E, Interface 1 Promiscuous Mode. (3 Marks)
Q1.A. Using X, Y of the Table:

Let S0 be the Window, Use Cohen-Sutherland line clipping algorithm to clip S1 and put the result as V, E table.

Q1.B. Find the Homogenous matrix to scale S1 by (1, 2, and 3) around V4.
Note: Verify your answer using at least two points.

Q2.A. Indicate X, Y location when scans converting E4 using DDA algorithm

Q2.B. List projection types with the homogenous matrix if present.

Q3.A. Answer one of the following:
1. Briefly define three types of hidden surface detection.
2. Define three of the following:
   A- OpenGl  B- Rendering  C- JPEG  D- Fractal  E- Blobby object

Q3.B. Using Bresenham's circle drawing to find the X, Y coordinates of the pixels which represent the circle of center at V2 and with radius of 7.

Q4.A. Briefly define three types of modeling.

Q4.B. Model fig. (1) with necessary not using:
1. Octree modeling to 1 X 1 cm.
2. BSP Tree to 2 X 2 cm.

Q5. Find the Homogenous matrix to scale S1 around V4.
Verify your answer using at least two points.
1. Write a C++ function for line clipping algorithm. (3 Marks)

2. Write a C++ function to mirror S1 around E4. (6 Marks)

3. Write three different functions to draw a filled rectangle. (6 Marks)
Q1 Find the system transfer function for the following Bode plot, then comment on the system's closed loop stability.

Q2 The poles location of a 2nd order system $G(s)$ is shown below:

$$G(s) = \frac{K}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

a) Find the system overshoot and the settling time.
b) Find $K$ if a unite step is applied and the steady-state output is 10.
Q3 A unit step response is plotted practically for an open-loop control system as shown bellow.

(a) Design an analog cascade PID controller of the form;

\[ u(t) = K_1 e(t) + K_2 \int e(t) dt + K_3 \dot{e}(t) \]

according to Ziegler-Nichols method.

(b) Convert such PID controller into digital form (difference equation) suitable to be programmed in a microcontroller using **backward rule** for differentiation and **Trapezoidal rule** for integration. (Choose suitable sampling time and give reason for your choice).

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Q4 Using sampling time (T=1 Sec.), find the zero-order hold equivalent transfer function \( G_{zoH}(z) \) for;

\[ G(s) = \frac{1 + 10s}{s^2} \]

Q5 Check the **stability** of the following digital control system:

\[ G(z) = \frac{0.8z^{-1}}{1 - 1.3z^{-1} + 0.46z^{-2} - 0.048z^{-3}} \]
Useful $s$ and $z$ Transforms:

<table>
<thead>
<tr>
<th>$X(s)$</th>
<th>$x(t)$</th>
<th>$x(kT)$ or $x(k)$</th>
<th>$X(z)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$-$</td>
<td>$-$</td>
<td>$1$</td>
</tr>
<tr>
<td>$\frac{1}{s}$</td>
<td>$1(t)$</td>
<td>$1(k)$</td>
<td>$\frac{1}{1-z^{-1}}$</td>
</tr>
<tr>
<td>$\frac{1}{s+a}$</td>
<td>$e^{at}$</td>
<td>$e^{akT}$</td>
<td>$\frac{1}{1-e^{aT}z^{-1}}$</td>
</tr>
<tr>
<td>$\frac{1}{s^2}$</td>
<td>$t$</td>
<td>$kT$</td>
<td>$\frac{Tz^{-1}}{(1-z^{-1})^2}$</td>
</tr>
<tr>
<td>$\frac{2}{s^3}$</td>
<td>$t^2$</td>
<td>$(kT)^2$</td>
<td>$\frac{T^2z^{-1}(1+z^{-1})}{(1-z^{-1})^3}$</td>
</tr>
</tbody>
</table>

**The Jury's test:** the necessary and sufficient conditions for the polynomial $Q(z)$ to have NO roots outside the unit circle are:

$Q(1) > 0$ \hspace{1cm} $(-1)^n Q(-1) > 0$

$|a_0| < a_n$ \hspace{1cm} $|b_0| > |b_{n-1}|$

$|c_0| > |c_{n-2}|$ \hspace{1cm} $|d_0| > |d_{n-3}|$

Where,

$Q(z) = a_n z^n + a_{n-1} z^{n-1} + \cdots + a_1 z + a_0 = 0$ \hspace{1cm} $(a_n > 0)$

$b_k = \begin{vmatrix} a_0 & a_{n-k} \\ a_n & a_k \end{vmatrix}$ \hspace{1cm} $k=0 \ldots n-1,$

$c_k = \begin{vmatrix} b_0 & b_{n-1-k} \\ b_{n-1} & b_k \end{vmatrix}$ \hspace{1cm} $k=0 \ldots n-2,$

$d_k = \begin{vmatrix} c_0 & c_{n-2-k} \\ c_{n-2} & c_k \end{vmatrix}$ \hspace{1cm} $k=0 \ldots n-3,$ and so on
Part I: Microcontroller & FPGA lab. (15 marks)

Q1.

A. Fill in the blanks (Choose only Five): (2.5 marks)

1. The 8051 microcontroller is programmed using files written in ................. format.

2. The type of the microcontroller chip used in the lab is: .................

3. One pulse advances the stepper motor rotor ................. degree.

4. The CLBs are .................

5. The FPGA consist of: ................. and .................

6. The steps of FPGA design implementation are: ................., ................. and .................

B. Write an 8051 assembly language program to do the following: (5 marks)

I. When the photo transistor (P3.4) is not blocked, the stepper motor (P2.0-P2.3) rotates right.

II. Else, the 7-segment (P3) will display the numbers from 0 to 9.

Note: use suitable delay

Q2.

A. Write a complete VHDL code to construct 32-bit RAM with 4 locations. (5 marks)
B. Draw one period of the input and output signal waveform for the following VHDL code.

```vhdl
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_ARITH.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;

entity exam is
  Port ( clk: in BIT;
         wave : out STD_LOGIC);
end exam;

architecture Behavioral of exam is
begin
  variable count:integer range 0 to 7;
  begin
    wait until (clk'event and clk='1');
    case count is
    when 0 => wave <= '0';
    when 1 => wave <= '0';
    when 2 => wave <= '1';
    when 3 => wave <= '0';
    when 4 => wave <= '0';
    when 5 => wave <= '1';
    when 6 => wave <= '1';
    when 7 => wave <= '0';
    end case;
    count := count+1;
  end process;
end Behavioral;
```

(2.5 marks)
Part II: Real time & Control lab. (15 marks)

Q1.

A. For the Feedback control trainer system

1. Explain the speed control system, take an example and draw if needed.
2. Complete the following table:-

<table>
<thead>
<tr>
<th>Position in Degree</th>
<th>80</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error voltage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(4 Marks)

B. Write down Matlab instructions to draw the (Root Locus, Pole Zero Map and Time Response) for the following system:

\[
\frac{S + 1}{S^2} \rightarrow \frac{1}{S} \rightarrow \frac{S}{S + 4} \rightarrow Y
\]

(3 Marks)

Q2.

A. The CDS sensor based on photo resistance is used for light monitoring application. Design a Labview VI to implement the following:
- The output signal of the sensor is acquired as an analog input to the DAQ
- Transmit the acquired signal to a remote supervisor computer with IP: 192.168.100.1

For the remote supervisory terminal
- Receives the signal from the remote node.
- Generate an alarm signal to flash the 8 LEDs connected to the digital output (port 0) when the received signal is below a threshold value (TH=2.4 volt).

*Note:* Use the following ports (61556, 61557) as a transmit and receive ports, respectively.

(B) (4 Marks)

1. Explain briefly the function of voltage regulator (LM7805CT).
2. Answer (True or False)
   - The pressure sensor used in the pressure monitoring experiment is a Pizeoelectric type.
   - The compensation circuit in the thermocouple experiment is used to compensate for the hot junction.
   - For the "DAQ assistant.VI", the RSE is configured when there are multiple analog inputs from the same circuit.
3. What is the purpose of the block 1 and 4 in transducer circuit shown below

![Transducer Circuit Diagram](image)

(4 Marks)

GOOD LUCK