COMSATS UNIVERSITY ISLAMABAD, Lahore Campus

Department of Electrical and Computer Engineering

Subject: Power Electronics (FA20-BEE-P,E)	**Course Code:** EEE338
Exam: Terminal (Theory)	**Total Marks:** 100
Time Allowed: 180 minutes	**Date:** Jan. 27, 2023
Student's Name:	
Registration Number: [redacted]	**Section:**

Instructions:

- This is a closed-book closed-notes exam
- Sharing of calculator is strictly prohibited
- Keeping cell phones with you, either in on or off condition, is not allowed

Question 1 (10+10 = 20 Marks) **(CLO2-PLO2-C4)**

a. A full-wave controlled rectifier, shown in figure 1, has following circuit parameters. Source voltage $V_s = 220\ V_{(rms)}$, $f = 50\ Hz, R = 10\Omega$. Analyse this circuit to find the delay angle for thyristors such that the load dissipated 500 Watts.

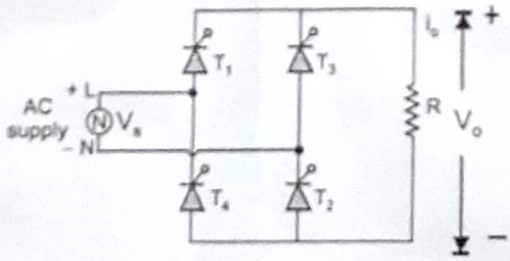


Figure 1

b. A $3-\phi$ full-wave converter is operated from a $3-\phi$ Y-connected AC source with line-to-line voltage of 210V. The source drives a pure resistive load with $R = 10\Omega$. If it is required to obtain the output voltage equal to the 60% of the maximum possible output voltage, then analyse the circuit for the following parameters.

i. The rms output current in the load
ii. The rms current in each thyristor
iii. Efficiency of the rectifier
iv. Transformer utilization factor (TUF)
v. Input power factor (PF_{in})

Question 2 (20 Marks) **(CLO3-PLO3-**

Design a boost converter that produces output voltage of 8V from an input DC source of 5V. Converter has to supply the load with 1A current. Converter should meet the following specifications.

i. Inductor current should not vary more than 40% of the average inductor current.

ii. Output voltage ripple should be no more than 2% of the required output voltage.

iii. Converter should operate in CCM at $f = 100kHz$

Question 3 (20 Marks) **(CLO3-PLO3-C5)**

Consider the specifications for a Buck-Boost converter given below.

$$V_{in} = 70V, R = 20\Omega, V_o = -45V, f = 200kHz$$

Design a buck-boost converter that operates in CCM and meets these given specifications.

Question 4 (2+2+2+2+4+4+4 = 20 Marks) **(CLO2-PLO2-C4)**

Consider the $3-\phi$ inverter, shown in figure 2, supplies a Y-connected load of $5+6j\ \Omega$ at 50Hz. Inverter is fed with 220V input. Analyse this inverter for the following parameters.

i. The rms line voltage

ii. The rms phase voltage

iii. The rms line voltage (V_{L1}) at fundamental frequency

iv. Total harmonic distortion (THD)

v. Distortion factor (DF)

vi. DF at the least-order harmonic

vii. Power delivered to the load

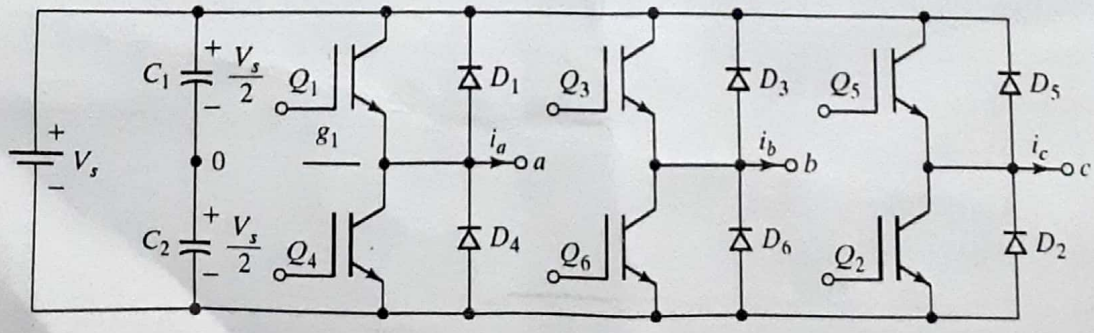


Figure 2

Question 5 (4 X 5 = 20 Marks) (CLO2-PLO2-C4)

Consider the $1-\phi$ full-wave AC-AC voltage controller shown in figure 3.

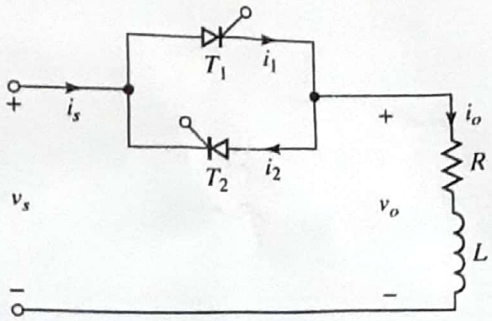


Figure 3

The input is $220V_{rms}, L = 6\ mH, R = 8\Omega$. For delay angle $\frac{\pi}{4}$ radians, analyse this converter for the following parameters.

i. The rms output voltage
ii. The rms current in one thyristor
iii. The rms output current
iv. Average current of one thyristor
v. Input power factor (PF_{in})

COMSATS UNIVERSITY ISLAMABAD, Lahore Campus

Department of Electrical and Computer Engineering

Subject:	**Power Electronics (FA20-BEE-E,P)**	**Course Code:**	**EEE338**
Exam:	**Mid-Term (Theory)**	**Total Marks:**	**50**
Time Allowed: 90 minutes		**Date:**	**Nov. 16, 2022**
Student's Name:			
Registration Number:	[redacted]	**Section:**	

Instructions:

- This is a closed-book closed-notes exam
- Sharing of calculator is strictly prohibited
- Keeping cell phones with you, either in on or off condition, is not allowed

Question 1 (10)

Explain the operation of SCR based on two-transistor model. Make use of diagrams and relevant figures. Also explain holding current and latching currents in the context of SCRs.

Question 2 (20)

The load in Fig. 1 consists of a resistance R and is supplied from a 3ϕ half-wave controlled rectifier.

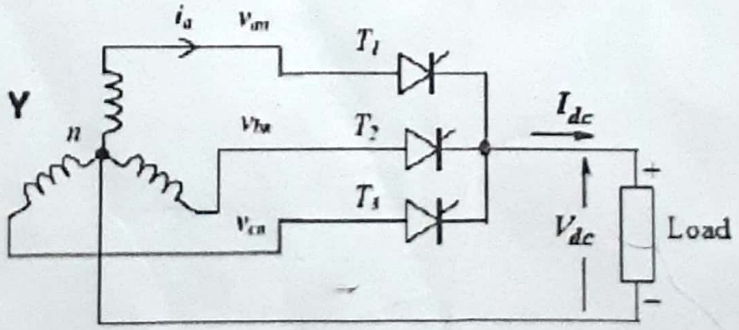


Fig. 1

Analyse this converter:

a. to sketch a set of waveforms for thyristor firing angle $\alpha = 45^o$ showing supply voltages (v_{an}, v_{bn}, v_{cn}), load voltage V_{dc} and load current I_{dc}.

b. to compute the average values of the output voltage and current if phase voltage peak is $V_m = 400\ V$ and $R = 100\ \Omega$ for $\alpha = 45^o$.

c. to compute the average value and RMS value of thyristor currents if phase voltage peak is $V_m = 400\ V$ and $R = 100\ \Omega$ for $\alpha = 60^o$.

d. Rectifier efficiency η.

e. Transformer utilization factor (TUF).

Question 3 (20)

a. Illustrate the operation of a DC-DC buck converter in both of its switching modes with the help of diagrams.

b. The DC-DC buck converter in Fig. 2 has the following parameters:

$$v_{in} = 30\ V, D = 0.4, L = 250\ \mu H, C = 100\ \mu F, f = 40\ kHz, R = 15\ \Omega$$

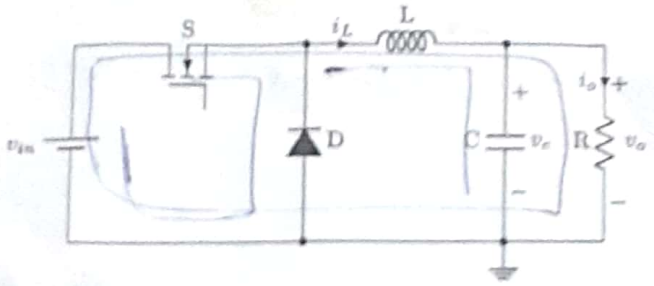


Fig. 2

Assuming S as ideal switch, analyse this converter for

i. the output voltage v_o

ii. maximum inductor current $i_{L,max}$

iii. minimum inductor current $i_{L,min}$

Formulae for problem 2.

$$V_{dc} = \frac{3\sqrt{3}V_m}{2\pi}cos(\alpha) = 0.827V_m\,cos(\alpha)$$

$$V_{rms} = \sqrt{3}V_m \cdot \sqrt{\left(\frac{5}{24} - \frac{\alpha}{4\pi} + \frac{1}{8\pi}sin\left(\frac{\pi}{3} + 2\alpha\right)\right)}$$

COMSATS University Islamabad, Lahore Campus

Mid-Term Examination – Spring 2022

Course Title:	Electromagnetic Theory				Course	EEE261	Credit 3(3,0)
Course Instructor/s:	Dr. Asim Ali Khan, Dr. Muhammad Nadeem Rafiq				Programme	BEE-T	
Semester:	3rd	Batch:	FA20-BEE	Section:	A, B & C	Date:	14-05-2022
Time Allowed:	90 min				Maximum Marks:		25

Important Instructions / Guidelines:

- Show the details of your work, providing just final answer is not acceptable.

Question 1: (02+06=08 Marks) (CLO1, C3)

The surfaces ρ = 3, ρ = 5, φ = 100°, φ = 130°, z = 3, and z = 4.5 define a closed surface.

Compute

(a) the enclosed volume;

(b) the total area of the enclosing surface.

Question 2: (02+03=05 Marks) (CLO2: C4)

A uniform volume charge density of 0.2 $\mu C/m^3$ is present throughout the spherical shell extending from r = 3 cm to r = 5 cm. If $\rho_v = 0$ elsewhere. ***Analyze*** the scenario for:

a) the total charge present throughout the shell,

b) the radius r_1 if half the total charge is located in the region 3 cm < r < r_1.

Question 3: (06 Marks) (CLO2: C4)

A uniform line charge of 16 nC/m is located along the line defined by y = -2, z = 5. ***Analyze*** how much Electric Field Intensity E is present at P(1, 2, 3):

Question 4: (03+03=06 Marks) (CLO2: C4)

An electric flux density is given by $\mathbf{D} = D_0 \mathbf{a}_\rho$, where D_0 is a given constant. ***Analyze*** this field for:

(*a*) The charge density generating this field?

(*b*) The total charge generating this field if this charge is contained within a cylinder of radius *a* and height *b*, where the cylinder axis is the *z* axis?

The following relationship may be of use:

$$\text{div } \mathbf{D} = \frac{1}{\rho}\frac{\partial}{\partial \rho}(\rho D_\rho) + \frac{1}{\rho}\frac{\partial D_\phi}{\partial \phi} + \frac{\partial D_z}{\partial z} \quad \text{(cylindrical)}$$

COMSATS University Islamabad (CUI), Lahore Campus
Department of Electrical and Computer Engineering
1.5 KM Defence Road, Off Raiwind Road, Lahore

Midterm – Spring 2022

Course Title:	Probability Methods in Engineering		Course Code:	EEE251 CPE251	Credit Hours:	3(3,0)
Course Instructor/s:	Dr. Ejaz Ansari, Dr. Farooq-i-Azam, Dr. Jawad, Dr. Zaid Ahmed, Syed Ahmed Faran		Programme Name:	BSEE, BCE		
Semester:	SP22 Batch: FA20		Section:	A,B,C		
Date	May 11, 2022		Maximum Marks:		50	
Student's Name:	[redacted]		Reg. No.	FA20-BE[redacted]		

Important Instructions:
- Sharing of calculator is not allowed.
- Write your answers clearly in detail along with method of solution.

Question 1 [C3, CLO1, PLO1] **[2,2,2,2,2] 10 Marks**

A company catalogues microcontrollers by its processing speed and cost. The microcontroller is categorized as lagging *(L)* if it executes less than 1 million instructions per second and fast *(F)* otherwise. The microcontroller is categorized as cheap *(C)* if it costs less than $5 and expensive *(E)* otherwise, Excahnge Rate is, 1 US $ = 189 Pak Rs.

Suppose you tour the company and work with some microcontrollers for purpose of testing. The probability model from your observation contains the following information: $P[C \cap F] = 0.5$, $P[E \cap F] = 0.2$, and $P[E \cap L] = 0.2$.

$M = \{L, F, C, E\}$

A. ***Show*** the sample space of the experiment.

B. ***Show*** the probability model of the experiment (using table or tree diagram)

C. ***Compute*** the following probabilities:

i. $P[L]$

ii. $P[E]$

iii. $P[L|E]$

$\frac{1}{5}$ $\frac{1}{4}$

$P(A|B) = \frac{P(A \cap B)}{P(B)}$

$\frac{1}{5} \times \frac{4}{5}$

Question 2: [C4, CLO2, PLO2] **[3,3,3,3,3,3,2] 20 Marks**

It can take up to four days after you call for service to get a customer's computer repaired. The computer company charges for repairs according to how long the customer must wait. The probability model of the number of days D until the service technician arrives is given as follows. In addition, the service charges C, in Rupees, are also described.

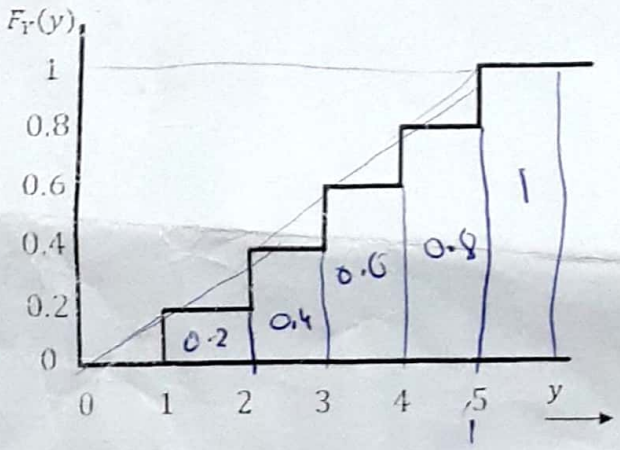
$$P_D(d) = \begin{cases} 0.2 & d = 1, \\ 0.4 & d = 2, \\ 0.3 & d = 3, \\ 0.1 & d = 4, \\ 0 & otherwise, \end{cases} \quad \text{and } C = \begin{cases} 80 & for\ 1-day\ service, \\ 60 & for\ 2-day\ service, \\ 40 & for\ 3-day\ service, \\ 40 & for\ 4-day\ service, \end{cases}$$

A. ***Analyze*** the problem to find expected waiting time $\mu_D = E[D]$
B. ***Illustrate*** C as a function of D
C. ***Analyze*** the problem to find, $P_C(c)$
D. ***Analyze*** the problem to find the expected value of C, $E[C]$
E. ***Compute***, the variance and standard deviation of C
F. ***Analyze*** the problem to find the CDF of C, $F_C(c)$
G. ***Sketch*** the CDF, $F_C(c)$

E[g-u]

Question 3: [C4, CLO2, PLO2] **[3,3,2,3,3,3,3] 20 Marks**

The discrete random variable Y has the CDF $F_Y(y)$ shown below.



A. ***Analyze*** the problem to find the PMF $P_Y(y)$
B. ***Illustrate*** the PMF $P_Y(y)$ in the form of a well defined graph
C. ***Identify*** the family to which the discrete random variable $P_Y(y)$ belongs to
D. ***Compute*** $P[Y < 1]$
E. ***Compute*** $P[Y \leq 1]$
F. ***Compute*** $P[Y = 3]$
G. ***Compute*** $P[Y > 3]$

0-6 6x1

$\sum^{r}$ |0.2| x

COMSATS University Islamabad, Lahore Campus
Defence Road, Off Raiwind Road, Lahore.

Mid-Term Examination – Fall 2021

Course Title:	Linear Algebra			Course Code:	MTH231	Credit Hours:	3(3,0)
Course Instructor/s:	Dr. Aqeel Khan			Programme Name:	BEE		
Semester:	3rd	Batch:	FA20	Section:	A-B-C	Date:	20-11-2021
Time Allowed:	**90 Minutes**			**Maximum Marks:**			**25**
Student's Name:	[redacted]			Reg. No.	FA20-BE[redacted]		

Important Instructions / Guidelines:

- Attempt all the questions.

Section 1

Question 1 (CLO1 +CLO2) **(5+5 marks)**

(A): Apply Gauss-Jordan method to solve the following system of equations:

$$x + y + z + w = 1$$
$$x + 2y + 2z + 2w = 0$$
$$x + 2y + 3z + 3w = 0$$
$$x + 2y + 3z + 4w = 0$$

(B): Find the inverse of the following matrix by using elementary row operations and verify the result as $A \times A^{-1} = I$:

$$A = \begin{pmatrix} 4 & -8 & 5 \\ 4 & -7 & 4 \\ 3 & -4 & 2 \end{pmatrix}$$

Section 2

Question 2(CLO3) **(4+4+7 marks)**

(A) Find the dimension of the subspace of P_2 consisting of all the vectors of the form $at^2 + bt + c$, where $c = 2a - b$.

(B) For what values of λ is the set of vectors $\{(\lambda^2 - 5, 1, 0), (4, -4, 6), (4, 6, -6)\}$ linearly dependent?

(C) Find the basis and dimension of the solution space of the system $Ax = 0$, where

$$\left(\begin{array}{cccc|c} 1 & 3 & 2 & -1 & 0 \\ -2 & 2 & 3 & 2 & 0 \\ 0 & 8 & 7 & 0 & 0 \\ 3 & 1 & 2 & 4 & 0 \\ -4 & 4 & 3 & -3 & 0 \end{array}\right)$$

COMSATS UNIVERSITY ISLAMABAD

Lahore Campus: Defence Road, Off Raiwind Road, Lahore
UAN: +92-42-111-001-007
Department of Electrical and Computer Engineering

Terminal Exam – Semester Fall 2022

Course Title:	Control Systems	Course Code:	CPE-325	Credit Hours:	4(3,1)
Course Instructor:	Dr. Jawad, Dr. Imran, Dr. Mujtaba, and Dr. Tariq	Program Name:	FA19-BCE-A&B FA20-BEE- A, B, & E		
Exam Date and Time:	31-01-2023 from 13:00 – 16:00				
Total Marks:	100	Obtained Marks:			
Student's Name:		Reg. No.	FA20-BEE-		

Note:

- Solve all the questions
- Questions must be solved with complete steps, no short cut allowed.
- ***All copied Exam scripts (cheating) will be marked zero.***
- No Exchange of calculators and any other material

Question 1: **[CLO2-PLO2:C4]** **[20 Marks]**

a. **Illustrate** the closed-loop transfer function $(G(s) = \frac{C(s)}{R(s)})$ of the system shown in ***Figure 1*** using any appropriate method (block diagram reduction or signal flow graph). ***Show*** complete steps of the solution.

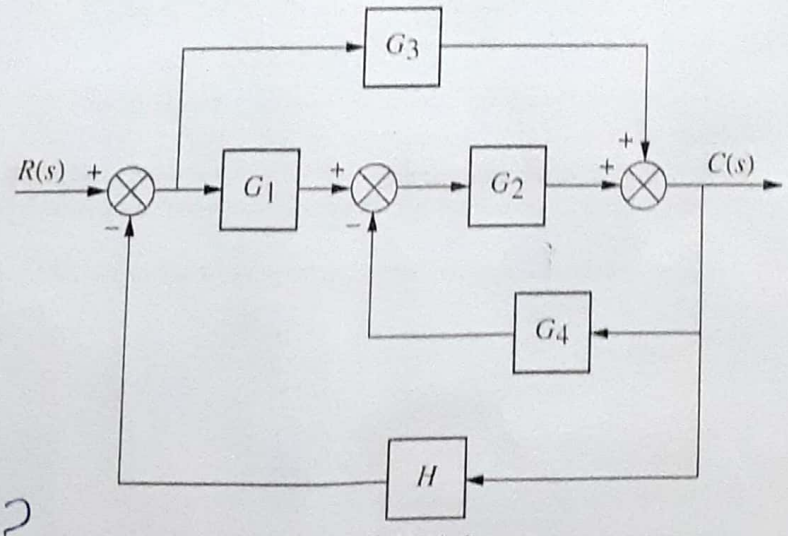


Figure 1. Block diagram

T.F = ?

Question 2: [CLO3-PLO3:C4] [12+18 = 30 Marks]

a. A unity Feedback system is given in ***Figure 2*** with $G(s) = \frac{e^{-0.2s}}{(s+5)}$, that is to be placed under PID control.

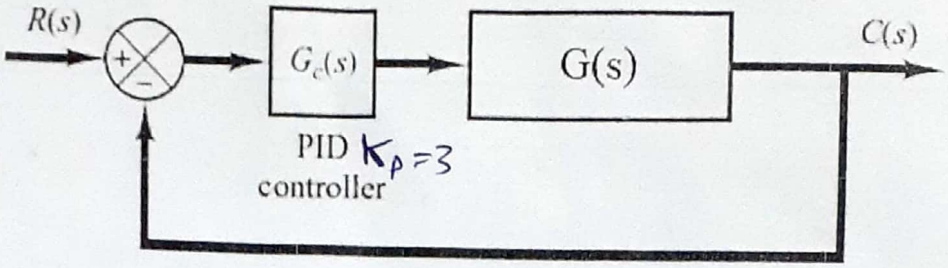


Figure 2. Unity Feedback System

i. ***Select*** the appropriate Ziegler-Nichols Method to ***identify*** the parameters (K_p, T_i and T_d) of corresponding PID controller. (6)

ii. In the PID controller, ***illustrate*** the impact of increasing the proportional constant (K_p) on peak time, settling time, and overshoot? (3)

iii. In the PID controller, ***illustrate*** the impact of increasing the derivative constant (K_D) on peak time, settling time, and overshoot? (3)

b. Consider an open-loop LTI system:

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -3 & 2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} U$$

$$y = [1\ 0\ 0]x + [0]\ U$$

The system uses the state feedback control $u = -Kx$ to get the desired stable response. Choose an appropriate location of stable closed-loop poles, where two poles will be complex conjugate ($s_{1,2} = -2 \mp j2$) and one pole will be a real-axis pole ($s_3 = -10$).

i. ***Identify*** whether the system is stable or unstable. Justify your answer. (3)

ii. ***Identify*** whether the given system is controllable. Justify your answer. (4)

iii. ***Design*** the state feedback controller using *any method* of pole placement technique. (6)

iv. ***Sketch*** the closed-loop control system block diagram including state Feedback Controller $u = -\begin{bmatrix} K_1 \\ K_2 \\ K_3 \end{bmatrix} x$. The Block diagram must be labeled with the actual computed values of the controller Gains. (5)

Question 3: [CLO3-PLO3:C5] [8+3+14 = 25 Marks]

a. For the given Bode plot in ***Figure 3***, ***Identify*** the transfer function of the system $G(s) = \frac{Y(s)}{R(s)}$? please show complete steps. (8)

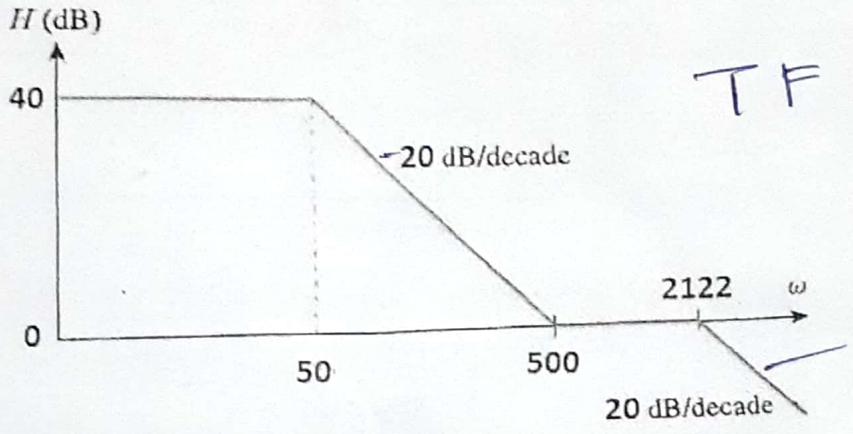


Figure 3. Bode Plot

b. For the system given in part (a), if the phase crossover frequency (w_{pc}) is 2122, ***identify*** the gain margin of the system. (3)

c. Consider the following open-loop plant Equation G(s):

$$G(s) = \frac{10}{(s^2 + 5s + 10)}$$

i. ***Sketch*** the Nyquist plot for the plant $G(s)$. (6)

ii. ***Interpret*** the following from the Nyquist plot

a) Start and end points (3)

b) Axis crossing points (3)

c) Is the system stable or unstable. (2)

Question 4: [7+5+2+2+4=20]

The block diagram of the unity feedback control system is shown in ***Figure 4***.

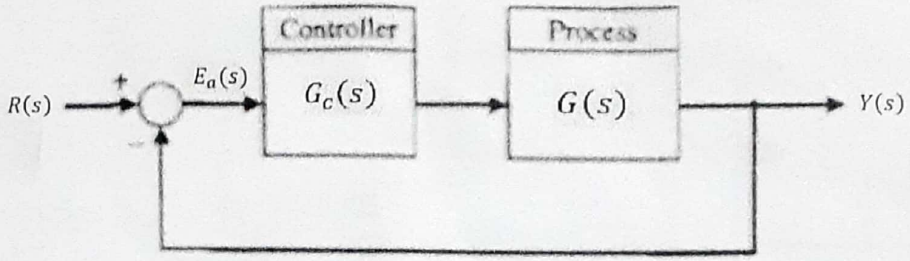


Figure 4. Unity Feedback Control System

Consider the process $G(s)$ and controller/compensator $G_c(s)$ having the transfer functions:

$$G(s) = \frac{1}{s-1} \quad \text{and} \quad G_c(s) = K\,\frac{s+z}{s+p}$$

i. Using the compensator design approach via root locus to ***identify*** the location of zero z such that the closed loop system has the dominant poles at the location $-3 \pm 4j$ given that pole p is located at -3. (7)

ii. ***Sketch*** the root locus of the compensated system. (5)

iii. ***Identify*** the value of the gain K at the dominant poles at the location $(-3 \pm 4j)$ (2)

iv. ***Describe*** using the results in Part(a) whether it is lead compensator or a lag compensator. Justify your answer. (2)

v. ***Compute*** and compare the steady state tracking error of the uncompensated and compensated system. (4)

COMSATS UNIVERSITY ISLAMABAD

Lahore Campus: Defence Road, Off Raiwind Road, Lahore
UAN: +92-42-111-001-007
Department of Electrical and Computer Engineering

Mid Term – Spring 2022

Course Title:	Electronics II	Course Code:	EEE-232	Credit Hours:	4(3,1)
Course Instructor:	Ms. Ayesha Ali,Ms. Amna Arif, Mr. Ali Raza	Program Name:	FA20 BEE		
Semester and Batch:	4th	**Date:**	13th May, 2022		
Time Allowed:	90 Minutes	Maximum Marks:	**50**		
Student's Name:	[redacted]	Reg. No.	FA20-BEE-[redacted]		

Note:

- ***Read the question paper carefully. All parts are compulsory.***
- ***Exchange of calculators or any other thing is strictly not allowed.***
- ***This is closed book/closed notes exam. No cheat sheet or formula tables are allowed.***
- ***Clearly write each step in all questions. Clearly draw diagrams where needed/asked. Marks will not be awarded for incomplete step.***

Question 1: **CLO1 PLO2 (15 Marks)**

Analyze the circuit given in Figure 1 and determine the following:

1. Determine r_e
2. Find A_{vmid}
3. Calculate Z_i
4. Determine f_{IG},f_{Ic}, and f_{Is}
5. Determine the lower cutoff frequency
6. Sketch the asymptotes of the Bode Plot defined by the cutoff frequencies of part 4

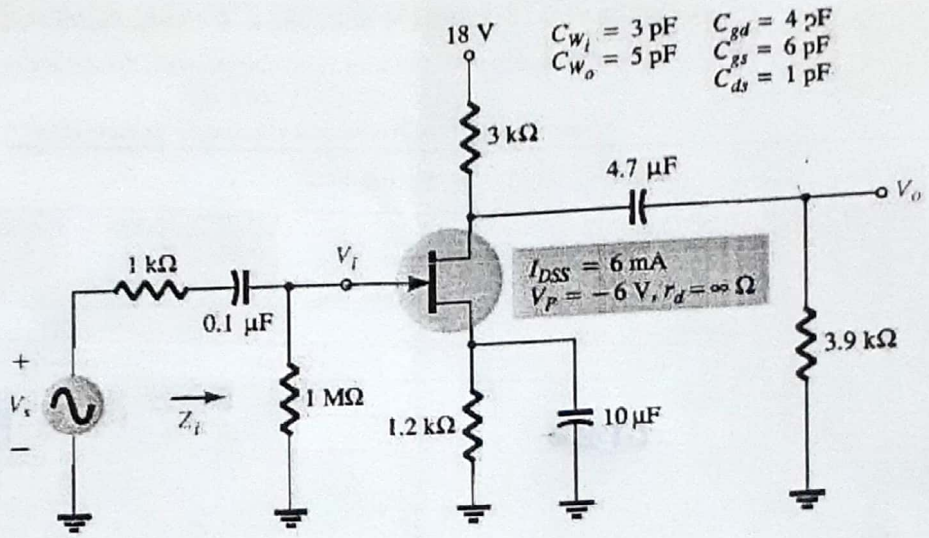


Figure 1

Question 2: **CLO1 PLO2** **(15 Marks)**

Analyze the circuit of Figure 2 and determine DC bias voltages V_{B1}, V_{B2}, and V_{c2}.

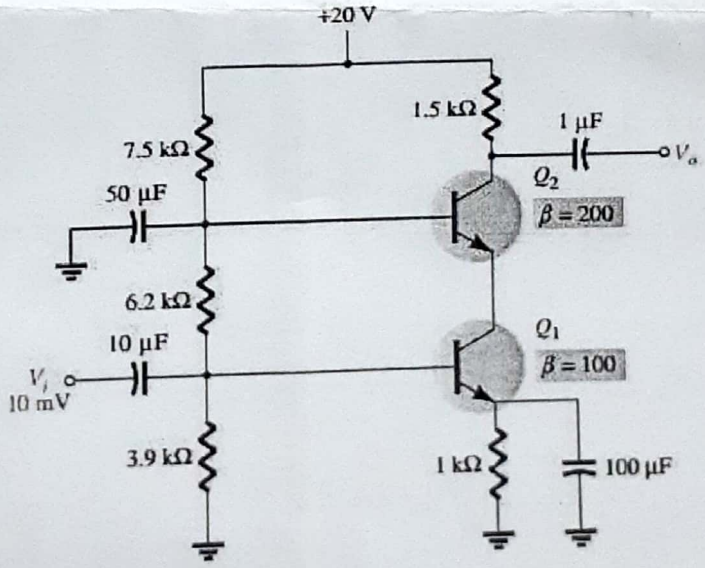


Figure 2

Question 3: **CLO1 PLO2** **(20 Marks)**

Analyze the circuit given in figure 3 and determine the following:

1. P_o(ac)
2. P_i(dc)
3. Efficiency
4. Power dissipated by each transistor

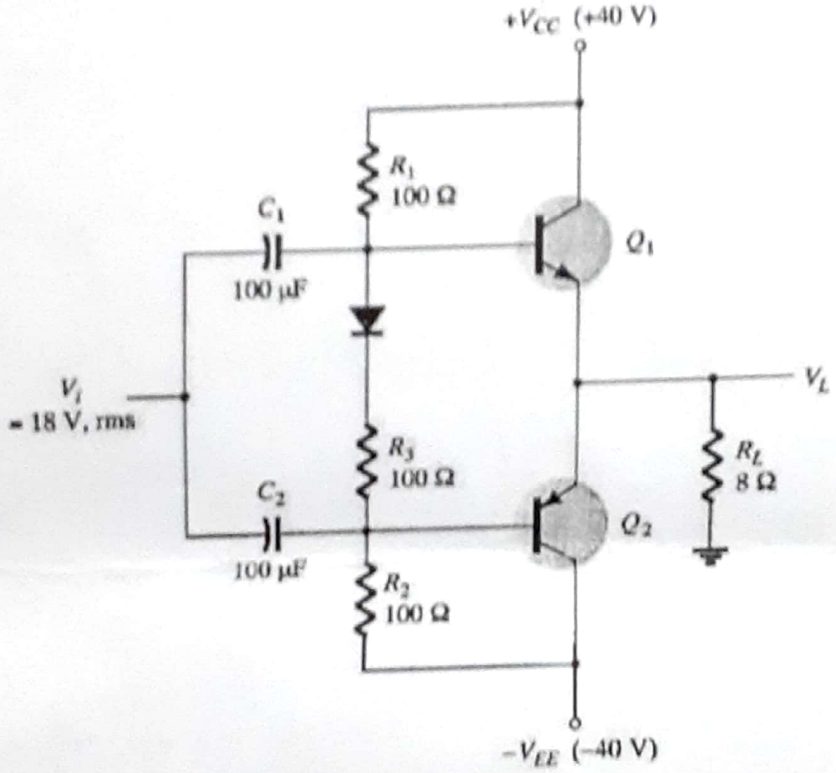


Figure 3

COMSATS University Islamabad

Lahore Campus, Defence Road, Off Raiwind Road Lahore

Ph: 042-99203109 Fax: 042-99205253

Department of Electrical and Computer Engineering

Midterm Examination – Spring 2022

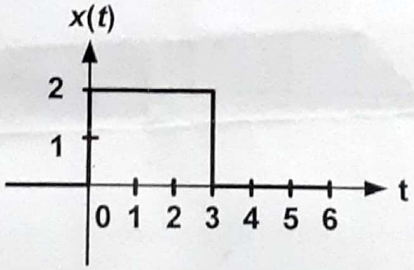
Course Title:	Signals and Systems			Course Code:	CPE223	Credit Hours:	4(3,1)
Course Instructor(s):	Dr. Saleem Akhtar, Dr. Ikramullah Khosa, Dr. Arsla Khan, Tabassum Nawaz Bajwa			Programme Name:	BSEE, BSCE		
Semester:	4	Batch:	Fall-20	Section:	A, B, C	Date:	May 10, 2022
Time Allowed:	**90 Minutes**			**Maximum Marks:**		**25**	

Important Instructions / Guidelines:

- No supporting material, notes and books are allowed during this examination. **A formula sheet has been provided at the end for students help.**
- The description must be supported by relevant figures and mathematical expressions, where required.
- All the figures should be legible and neatly drawn, where applicable.

Question 1: [CLO1-C3-PLO1] **(3+4 points)**

a. A waveform $x(t)$ is given below:



Compute and plot the following signals:

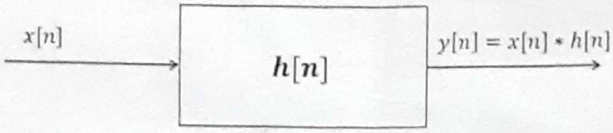
1. $y_1(t) = \frac{dx(t)}{dt}$
2. $y_2(t) = x(t-2)\,u(t-2)$
3. $y_3(t) = y_1(t) \times y_2(t)$

b. Demonstrate whether each of the following signals is periodic or aperiodic. If the signal is periodic, compute its fundamental period.

1. $x_1[n] = e^{j(2\pi/3)n} + e^{j(3\pi/4)n}$
2. $x_2(t) = e^{(-1+j)t}$

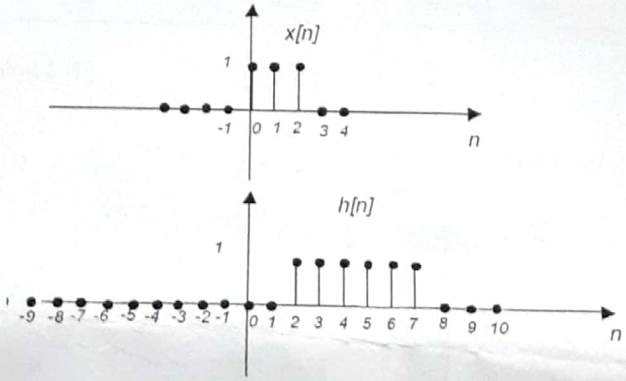
Question 2: [CLO1-C3-PLO1] **(4+2+2+1 points)**

The input $x[n]$ and impulse response $h[n]$ of a Discrete Time LTI Systems S are given and depicted as below



$$x[n] = \delta[n] + \delta[n-1] + \delta[n-2]$$

$$h[n] = \delta[n-2] + \delta[n-3] + \delta[n-4] + \delta[n-5] + \delta[n-6] + \delta[n-7]$$



a. Compute and plot $y_1[n] = x[n] * h[n]$ using DT convolution sum equation.

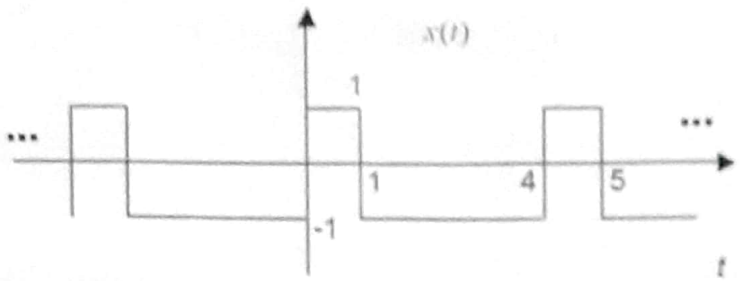
b. By applying the time shifting property of the DT convolution, modify your answer found in Part (a) to compute $y_2[n] = x[n-2] * h[n]$.

c. By applying the distributive and linearity property, compute $y_3[n] = (x[n] + x[n-2]) * h[n]$

d. Demonstrate that the DT LTI System S is BIBO stable.

Question 3: [CLO1-C3-PLO1] **(1+5+3 points)**

A continuous time periodic signal is depicted below



- Compute the fundamental frequency ω_0 and first five harmonics i.e., $\omega_k = k\omega_0$ $(k = 1,2,\cdots 5)$ for this periodic signal.
- Compute the equivalent exponential Fourier series coefficients of $x(t)$ using direct method (analysis equation). Numerically compute the coefficients a_k (magnitude and phase) up to the second harmonic frequency i.e., $k = 0, \pm 1, \pm 2$. Don't worry, if you can't simplify the FS coefficient expression after the integration. However, you are required to compute the magnitude and phase of a_k coefficients for $k = 0, \pm 1, \pm 2$ correctly by using the standard scientific calculators.
- This periodic signal $x(t)$ is also applied to an LTI systems which has low-pass filter $H(\omega)$ as its frequency response.

$$H(\omega) = \begin{cases} -10 & -\frac{\pi}{4} < \omega < \frac{\pi}{4} \\ 0 & \text{otherwise} \end{cases}$$

Find the Fourier series coefficients b_k of the output signal $Y(\omega)$ and the output $y(t)$ by using the synthesis equation.

Some Useful Formulae

1) A DT signals $e^{j(\omega_0)n}$ is periodic with fundamental period N, if $\frac{\omega_0}{2\pi} = \frac{m}{N}$, i.e $\frac{\omega_0}{2\pi}$ must be a rational number

$\Rightarrow m$ and N both integers, $N > 0$. Fundamental frequency $= \frac{\omega_0}{m}$

Linearity of Periodic Signals: If $x_1[n]$ is a DT periodic signal with fundamental period N_1 and $x_2[n]$ is another periodic signal with fundamental period N_2, then $x[n] = x_1[n] + x_2[n]$ is also periodic with fundamental period $\text{LCM}(N_1, N_2)$.

2) DT Convolution Sum for Finite Sequences:

If $x[n]$ is N point sequence ranging from 0 to $N-1$ and

$h[n]$ is an M point sequence ranging from 0 to $M-1$ then

$y[n] = x[n] * h[n] = \sum_{k=0}^{N-1} x[k]h[n-k]$ or $y[n] = h[n] * x[n] = \sum_{k=0}^{M-1} h[k]x[n-k]$

3) Time Shifting Property: If $x[n] * h[n] = y[n]$

Then

$$x[n-n_0] * h[n] = y[n-n_0]$$
$$x[n] * h[n-n_1] = y[n-n_1]$$
$$x[n-n_0] * h[n-n_1] = y[n-n_0-n_1]$$

4) Distributive Property:

$$[x_1[n] + x_2[n]] * h[n] = x_1[n] * h[n] + x_2[n] * h[n]$$
$$x[n] * (h_1[n] + h_2[n]) = x[n] * h_1[n] + x[n] * h_2[n]$$

5) Continuous Time Fourier series

$x(t) = \sum_{-\infty}^{\infty} a_k e^{jk\omega_0 t} = \sum_{-\infty}^{\infty} a_k e^{j\omega_k t}$ Synthesis Equation

$a_0 = \frac{1}{T_0}\int_0^{T_0} x(t)dt$ $\quad a_k = \frac{1}{T_0}\int_{T_0} x(t)e^{-jk\omega_0 t}dt$ Analysis Equation

6) Useful Integral $\int e^{ax}dx = \frac{1}{a}e^{ax}$

7) For Real Valued CT Periodic Signals, the Fourier series coefficients

$a_k = a_{-k}^*$ or $a_k^* = a_{-k}$

$|a_k| = |a_{-k}|$ $\quad \measuredangle a_k = -\measuredangle a_{-k}$

If a_k are also real, then from real valued periodic signals $a_k = a_{-k}$

8) Fourier Series and LTI Systems Output

$x(t) \overset{FS}{\leftrightarrow} a_k$ $\quad y(t) \overset{FS}{\leftrightarrow} b_k$ $\quad b_k = a_k H(jk\omega_0) = a_k H(j\omega_k)$

$$y(t) = \sum_{-\infty}^{\infty} b_k e^{jk\omega_0 t}$$

9) BIBO Stable Systems: A DT LTI system is BIBO stable if $\sum_{k=-\infty}^{\infty}|h[k]| < B$

The above condition is sufficient and necessary condition if $|x[n]| < B$ then $|y[n]| < B$

10) Complex Numbers $z = a + jb = re^{j\angle\theta} = |z|e^{j\angle z}$

$e^{-jk2\pi} = 1$ $\quad e^{\pm j\frac{\pi}{2}} = \pm j$ $\quad e^{\pm j\pi} = -1$

COMSATS UNIVERSITY ISLAMABAD, LAHORE CAMPUS

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Terminal Exam – SP2023

Course Title:	Industrial Electronics			Course Code:	EEE 435	Credit Hours:	4(3,1)
Course Instructor:	Ali Mansoor Pasha			Programme Name:	BEE		
Semester:	6th	Batch: FA20-BEE	Section:	E & P	Date:	23-6-2023	
Time Allowed:	**3 Hours**			**Maximum Marks:**		**50**	
Student's Name:				Reg. No.			

Important Instructions / Guidelines:

- Attempt all Questions on the answer sheet in proper sequence.
- Sharing of utensils, tools and calculator is not allowed.
- Use of mobile phone is prohibited in the examination room.

Question 1: **CLO2-C5-PLO3** **10 Marks**

An RTD has $\alpha_0 = 0.005/°C$, $R = 500\Omega$ and a dissipation constant of $P_D = 30$ mW/°C at 20°C. The RTD is used in a bridge circuit such a that in Figure 1 with $R_1 = R_2 = 500\Omega$ and R_3 a variable resistor used to null the bridge. If the supply is 10 V and the RTD is placed in a bath at 0°C, **design** the value of R_3 to null the bridge.

8.85×10^{-12} $R = 1.8c + 491.67$

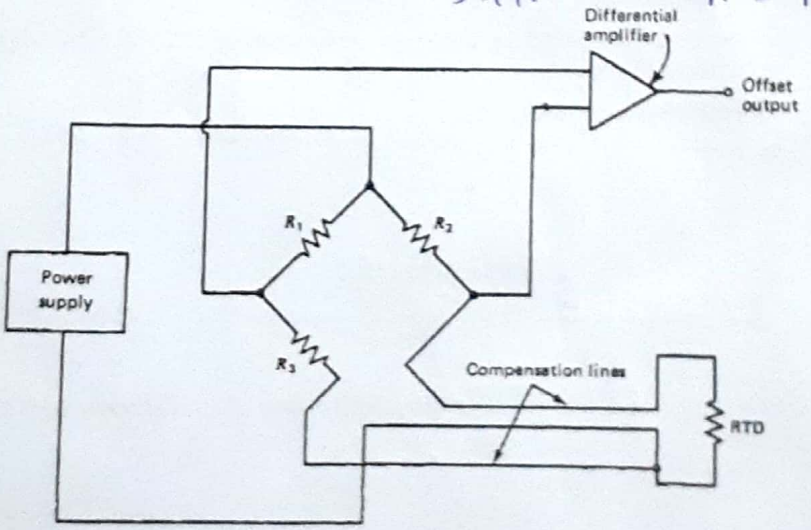


Figure 1

Question 2: **CLO2-C5-PLO3** **10 Marks**

art (a):

he level of Ethyl alcohol is to be measured from 0 to 5 m using capacitive system such as that shown in Figure 2. The llowing specifications define the system:

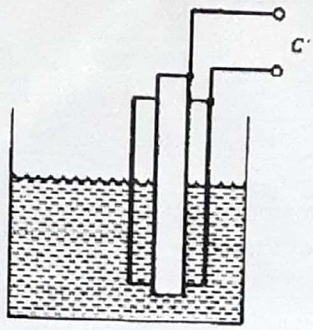
For Ethyl alcohol: K = 26 (for air, K = 1)
Cylinder separation: d = 0.5 cm
Plate area: A = πRL

here

R = 5.75 cm = average radius

L = distance along cylinder axis 5m

Design the range of capacity variation as the alcohol level varies from 0 to 5 m.



Level measurement by a concentric cylindrical capacitor

Figure 2

Part (b):

An accelerometer has a seismic mass of 0.05 kg and a spring constant of 3 x 10^3 N/m. Maximum mass displacement is $\pm$ 0.02 m (before the mass hits the stops). Calculate:

(i) The maximum measurable acceleration in **g**

(ii) The natural frequency

Question 3: **CLO2-C5-PLO3** **10 Marks**

Part (a):

A microwave source emits a pulse of radiation at 1 GHz with a total energy of 1 J. **Estimate** the following:

(i) The energy per photon

(ii) The number of photons in the pulse

Part (b):

Germanium has a band gap of 0.67 eV. Find the maximum wavelength for resistance change by photon absorption. Note that 1.6 x 10^{-19} J = 1 eV

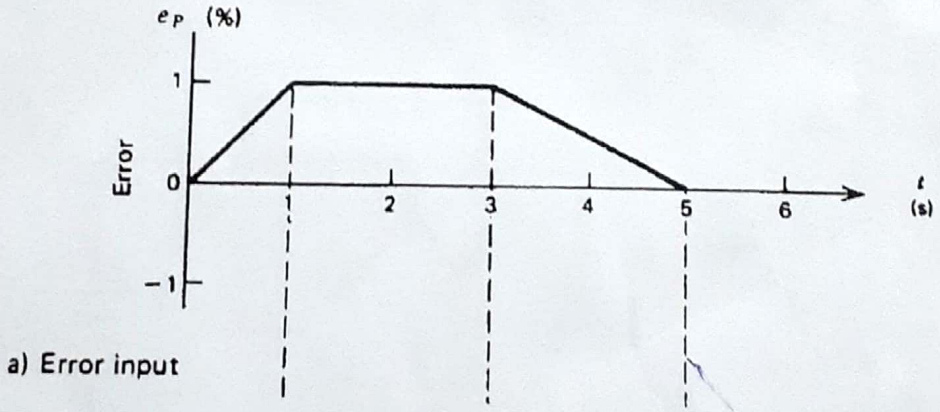
Question 4: **CLO1-C4-PLO2** **10 Marks**

A 4-bit digital word is intended to control the setting of a 2-Ω dc resistive heater. Heat output varies as a 0-24 V input to the heater. Using a 10-V DAC followed by an amplifier and a unity gain high-current amplifier, **calculate** the following:

(a) The settings from minimum to maximum heat dissipation
(b) How the power varies with LSB changes

Question 5: **CLO1-C4-PLO2** **10 Marks**

The following Figure 3 shows the error of a system with $K_P = 5$, $K_I = 0.7\ s^{-1}$, $K_D = 0.5$ s and $p_I(0) = 20$ %. **Calculate** the three-mode (PID) controller output. Also draw a plot of the controller output.



a) Error input

Figure 3

The End

COMSATS University Islamabad, Lahore campus

Mid Term Examination – Spring 2023

Course Title:	Digital Signal Processing	Course Code:	EEE324	Credit Hours:	4(3,1)
Course Instructor:	Dr. Khurram Ali, Mian Yasir	Program Name:	BS Electrical Engineering		
Semester:	6th Batch: FA20-BEE Section:		Date:	May 9, 2023	
Time Allowed:	1.5 hours	Maximum Points:		25	
Student's Name:	[redacted]	Reg. No.			

Instructions:
- This is a closed-book/closed-notes examination.
- A non-programmable, non-graphical calculator may be used.

Question 1 (CLO1) (3 + 5 = 8)

A) An Analog signal $x_a(t) = \sin(480\pi t) + 3\sin(720\pi t)$ is sampled at $600Hz$.

(i) Compute the Nyquist sampling rate for $x_a(t)$.

(ii) Compute the folding frequency.

(iii) What are the frequencies, in radians, in the resulting discrete time signal $x(n)$?

B) Compute the auto-correlation of the sequences given below. Write your answer in a form clearly indicating the term corresponding to lag zero:

(i) $x_1(n) = u(n) - u(n-4)$

(ii) $x_2(n) = e^{j\pi}\{u(n-1000) - u(n-1004)\}$

What do you infer from the results obtained in part **(i)** and **(ii)**?

Question 2 (CLO1) (8 + 4 = 12)

A) The system function of a certain causal LTI system is given by:

$$H(z) = \frac{1 - z^{-1}}{1 + \frac{3}{4}z^{-1}}$$

The input to the system is $x(n) = \left(\frac{1}{3}\right)^n u(n) + u(-n-1)$. Compute the impulse response of the system, $h(n)$ and the output $y(n)$.

B) Determine the magnitude and phase spectra of the discrete signal $x(n) = 4\sin\frac{\pi(n-2)}{3}$.

Question 3 (CLO2) (5)

Determine the Direct Form I and the Transposed Direct Form II structure of the IIR Filter described by the following difference equation:

$$y(n) = 0.5y(n-1) - 0.76y(n-2) + 0.63y(n-3) + x(n) + 0.875x(n-1)$$

COMSATS University Islamabad, Lahore Campus

Department of Electrical and Computer Engineering

Terminal-Examination – Spring 2023

Course Title:	Electric Machines			Course Code:	EEE371	Credit Hours:	4(3,1)
Course Instructor:	Dr. Nadeem Rafiq, M. Talha Raheem			Program Name:	BSEE		
Semester:	6th	Batch: FA20	Section:	E, P, T	Date:		
Time Allowed:	**180 Minutes**			**Maximum Marks:**		**50**	
Student's Name:	[redacted]			Reg. No.	FA20-BEE[redacted]		

Important Instructions / Guidelines:

- This is a closed book examination.
- Use of mobile phone during the examination is strictly prohibited.
- Attempt all the questions; there is NO choice in the questions.
- All questions must be answered in the same order as mentioned in the question paper.

Question 1: **[CLO1, C3]** **[2+1+2+1+2+2=10 marks]**

A 10-hp 120-V 1000 r/min shunt dc motor shown in figure 1has a full-load armature current of 70 A when operating at rated conditions. The armature resistance of the motor is $R_A = 0.12\ \Omega$, and the field resistance R_F is 40 Ω. The adjustable resistance in the field circuit may be varied over the range from 0 to 200 Ω and is currently set to 100 Ω. Armature reaction may be ignored in this machine. The magnetization curve for this motor, taken at a speed of 1000 r/min, is given in tabular form below:

E_A, V	5	78	95	112	118	126	130
I_F, A	0.00	0.80	1.00	1.28	1.44	2.88	4.00

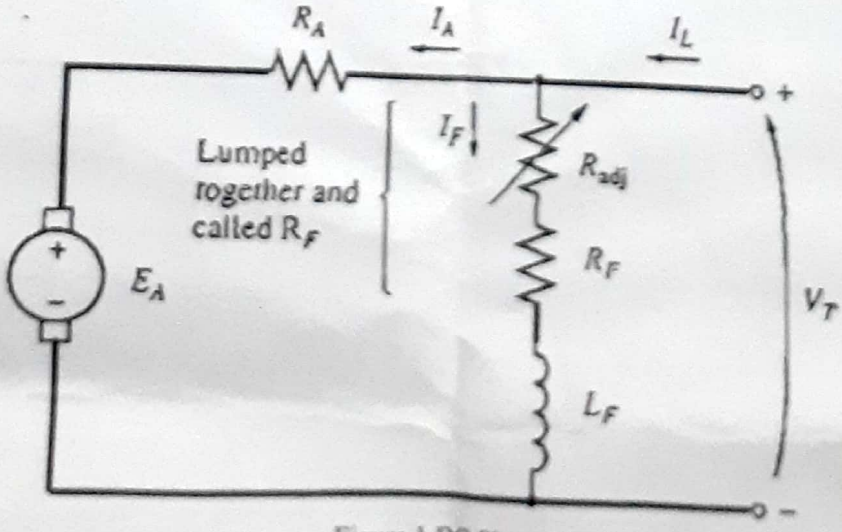


Figure 1 DC Shunt Motor

a) ***Compute*** the speed of this motor when it is running at the rated conditions specified above?

b) ***Compute*** the output torque of the motor?

c) ***Compute*** the copper losses and rotational losses in the motor at full load (ignore stray losses).

d) ***Compute*** the efficiency of the motor at full load?

e) If the motor is now unloaded with no changes in terminal voltage or R_{adj}, ***compute*** the no-load speed of the motor.

f) Suppose that the motor is running at the no-load conditions described in part (e). What would happen to the motor if its field circuit were to open? Ignoring armature reaction, ***compute*** the final steady-state speed of the motor be under those conditions.

Question 2: **[CLO1, C3]** **[2+2+1+2+2+3+3=15 marks]**

A 2300-V 1000-kVA 0.8-PF-lagging 60-Hz two-pole Y-connected synchronous generator has a synchronous reactance of 1.1 Ω and an armature resistance of 0.15 Ω. At 60 Hz, its friction and windage losses are 24 kW, and its core losses are 18 kW. The field circuit has a dc voltage of 200 V, and the maximum I_F is 10 A. The resistance of the field circuit is adjustable over the range from 20 to 200 Ω. The OCC of this generator is shown in figure 2.

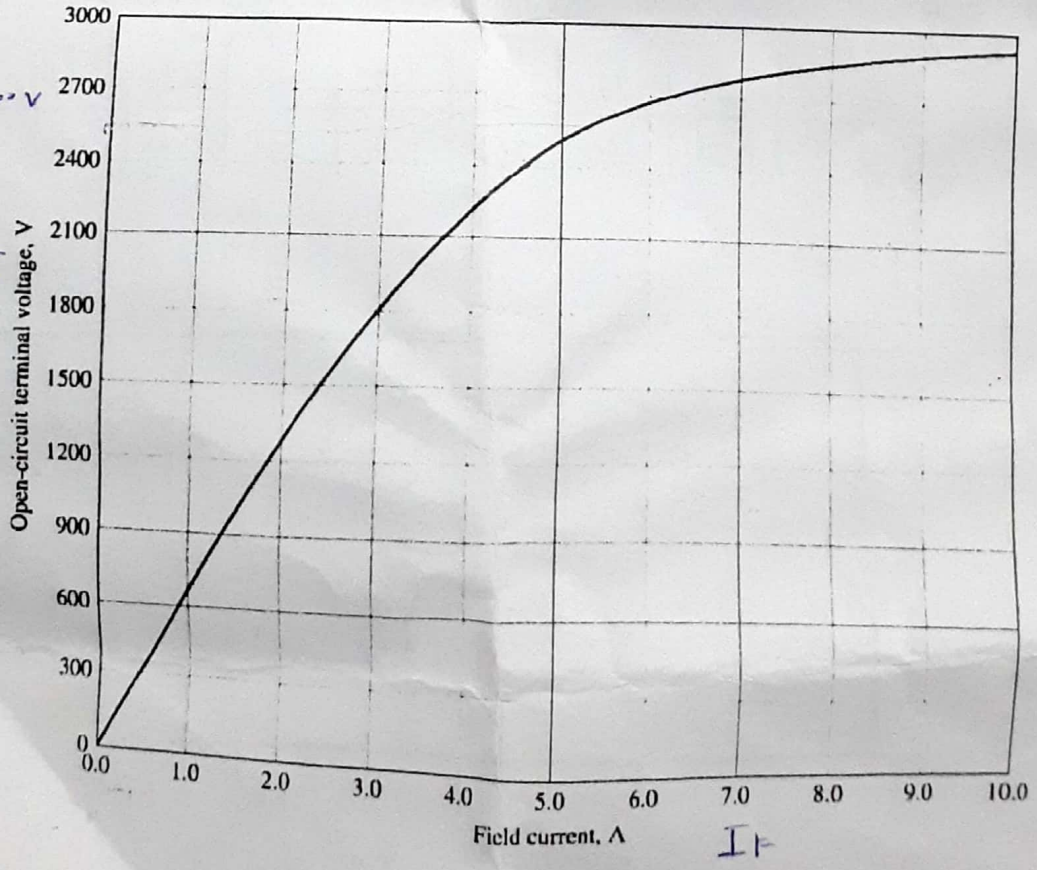


Figure 2 OCC of Synchronous Generator

a) ***Compute*** the field current required to make V_T equal to 2300 V when the generator is running at no load.

b) ***Compute*** the internal generated voltage of this machine at rated conditions.

c) ***Compute*** field current is required to make V_T equal to 2300 V when the generator is running at rated conditions?

d) ***Compute*** the power and torque of generator's prime mover.

e) ***Compute*** the efficiency of the generator at rated load?

f) ***Compute*** the voltage regulation of the generator if it is loaded to rated kilovolt amperes with unity power factor loads?

g) ***Compute*** the voltage regulation of the generator if it is loaded to rated kilovolt amperes with 0.8-PF-leading loads?

Question 3: **[CLO2, C4]** **[4+2+4=10 marks]**

A 208-V, 40hp, 0.8-PF-leading, Δ-connected, 60-Hz synchronous machine has a synchronous reactance of 2.5 Ω and a negligible armature resistance. Its friction and windage losses are 1.5 kW, and its core losses are 1.0 kW. Initially, the shaft is supplying a 15-hp load, and the motor's power factor is 0.80 leading

a) ***Illustrate*** the phasor diagram of this motor, and find the values of I_A, I_L, E_A.

b) Assume that the shaft load is now increased to 30 hp. ***Illustrate*** the behavior of the phasor diagram in response to this change.

c) ***Compute*** I_A, I_L, E_A after the load change. What is the new motor power factor?

Question 4: **[CLO2, C4]** **[3+2+2+1+2+2+2+1=15 marks]**

A 208-V, four-pole, 60-Hz, Y-connected wound-rotor induction motor is rated at 30 hp. Its equivalent circuit components are

$R_1 = 0.100\Omega$ $R_2 = 0.070\Omega$ $X_M = 10\Omega$

$X_1 = 0.210\ \Omega$ $X_2 = 0.210\ \Omega$

$P_{mech} = 500W$ $P_{misc} = 0$ $P_{core} = 400W$

For a slip of 0.05, ***Illustrate***

a) The line current I_L

b) The stator copper losses P_{SCL}

c) The air-gap power P_{AG}

d) The power converted from electrical to mechanical form P_{conv}

e) The induced torque τ_{ind}

f) The load torque τ_{load}

g) The overall machine efficiency

h) The motor speed in revolutions per minute and radians per second

COMSATS UNIVERSITY ISLAMABAD, Lahore Campus

Department of Electrical and Computer Engineering

Subject: Industrial Electronics (FA20-BEE-L, P)	**Course Code:** EEE435
Exam: Mid-Term (Theory)	**Total Marks:** 50
Time Allowed: 90 minutes	**Date:** May 10, 2023
Student's Name:	
Registration Number: FA20-BEE-	**Section:**

Instructions:

- This is a closed-book closed-notes exam
- Sharing of calculator is strictly prohibited
- Keeping cell phones with you, either in on or off condition, is not allowed

Question No. 1 (CLO1-C4-PLO2) [15]

Consider the following system shown in Figure 1 involving simple blending of water and acid in a container where we only have three level sensors (L1, L2, *and L3)* and two liquids flowing in through two solenoid valves, solenoid **a** (water control) and *solenoid* **b** *(acid* control) and draining out through solenoid **c** (blend outflow). The batch is to be controlled *by timer.* After required level of blend is sensed (by L1) the mixer runs for 3 mins, by the motor. *They are mixed in* ratio of 3:2. The process initiates with the drain valve open, water and acid valves closed, *mixer motor* is off, and the tank is empty. **Create** the Ladder diagram for this system and *write its observation (explanation).*

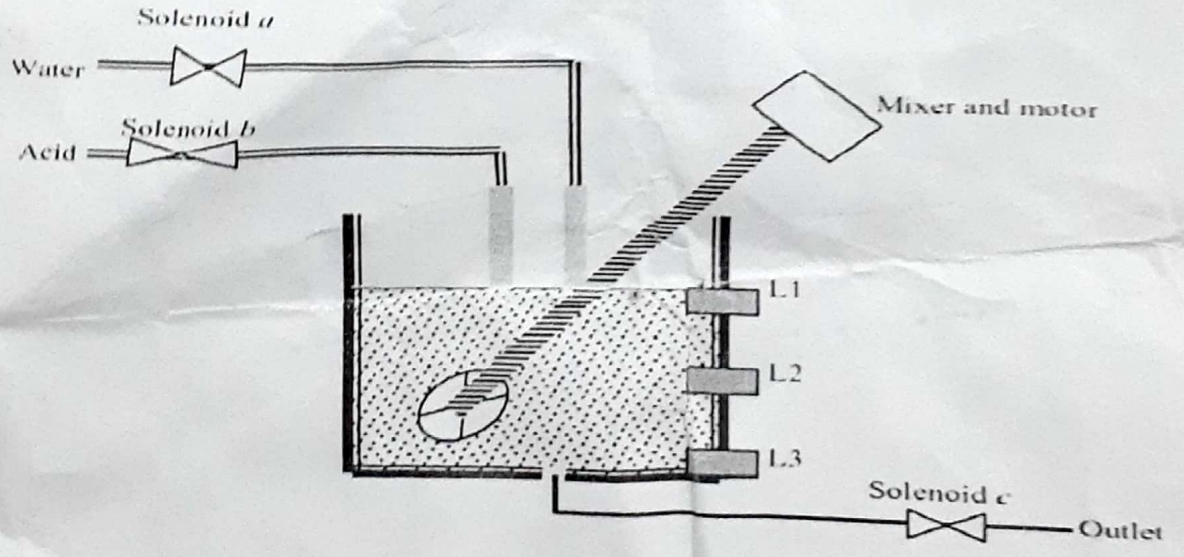


Figure 1

Question No. 2 (CLO3-C2-PLO6) [5]

Identify some Electric hazards which the workers might face at an industry. Also suggest some methods to prevent from accidents by Electrical hazards.

Question No. 3 (CLO1-C4-PLO2) [10]

Part (a):

A slab of insulating material 0.015 m^2 in area and 0.01 m in thickness has relative permittivity of 5 and power factor of 0.05 (leading) and is to be heated by dielectric heating. The power required is 400 W at a frequency of 30 MHz. **Calculate** the voltage required and the resulting current that will flow through the material. If the voltage were to be limited to 650 V, what would be the value of frequency for the same power requirement?

Question No. 3 (CLO1-C4-PLO2) [5]

Part (b):

Briefly **differentiate** between the principles of Induction heating and Dielectric heating.

Question No. 4 (CLO2-C5-PLO3) [15]

Consider a split air-conditioner system in a room whose temperature is set at 22 °C. **Construct** a block diagram which describes the complete system including the temperature control and switching off of the outdoor unit when the temperature of the room reaches the set-point 22 °C. For this system, also briefly elaborate the following five elements:

(a) Process

(b) Measurement

(c) Error Detector

(d) Controller

(e) Control Element

The End

Question No. 2

(CLO3-C2-PLO6) [5]

Identify some Electric hazards which the workers might face at an industry. Also suggest some methods to prevent from accidents by Electrical hazards.

Question No. 3

Part (a):

(CLO1-C4-PLO2) [10]

A slab of insulating material 0.015 m^2 in area and 0.01 m in thickness has relative permittivity of 5 and power factor of 0.05 (leading) and is to be heated by dielectric heating. The power required is 400 W at a frequency of 30 MHz. **Calculate** the voltage required and the resulting current that will flow through the material. If the voltage were to be limited to 650 V, what would be the value of frequency for the same power requirement?

Question No. 3

Part (b):

(CLO1-C4-PLO2) [5]

Briefly **differentiate** between the principles of Induction heating and Dielectric heating.

Question No. 4

(CLO2-C5-PLO3) [15]

Consider a split air-conditioner system in a room whose temperature is set at 22 °C. **Construct** a block diagram which describes the complete system including the temperature control and switching off of the outdoor unit when the temperature of the room reaches the set-point 22 °C. For this system, also briefly elaborate the following five elements:

(a) Process

(b) Measurement

(c) Error Detector

(d) Controller

(e) Control Element

The End

COMSATS University Islamabad, Lahore Campus

☐ **Midterm Examination** ■ **Terminal Examination – SPRING 2023**

Course Title:	VLSI Design				Course Code:	CPE/EEE 434	Credit Hours: 4(3,1)
Course Instructor:	Dr. Muhammad Naeem Awais, Ms. Madiha				Programme	BCE, BEE	
Semester:	6th,8th	Batch:	FA19, FA20	Section:	A, B, E	Date:	
Time Allowed:	**180 Minutes**				**Maximum Marks:**		**100**
Student's Name:					Reg. No.	FA20-BEE-	

Important Instructions / Guidelines:

- Write your Student's Name and Reg. No. clearly on the first page.
- The exam is closed book, closed notes.
- Mobile phones are not allowed in the examination room.
- Sharing of Calculator is not allowed. (Use your own calculator).
- Attempt all questions.

Question 1:[CLO1-PLO1-C3] **Marks 20**

a) Apply Elmore delay model to calculate the delay from In to Out1, Out2, and Out3 for the given RC network in Figure 1.

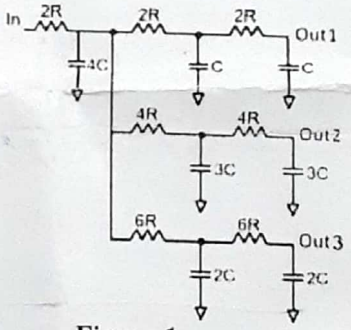


Figure 1

b) Apply linear delay model to estimate the minimum delay for the path from A to B and identify the transistor sizes to achieve this minimum delay for the given circuit in Figure 2.

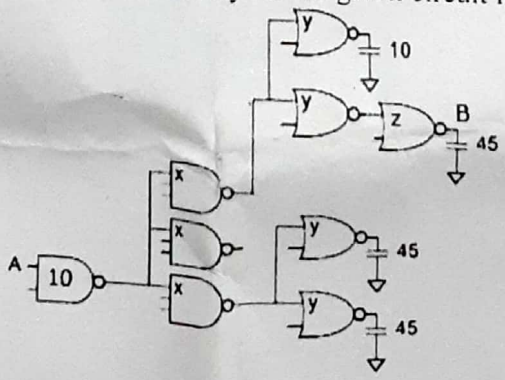


Figure 2

Question 2:[CLO3-PLO3-C5] **Marks 20**

Design the following set of circuits for the given Boolean function at transistor level:

$$Y = A.B.C + D.E$$

a) Complementary Pass-transistor Logic using a 4x1 MUX. (Hint: Use Shannon's Expansion Theorem)

b) Skewed gate with compound CMOS logic with the skewing factor of 2 as the rising output of the circuit is most critical. What will be the sizes of transistors in the design and how much will be the logical effort for each input.

Question 3:[CLO2-PLO2-C4] **Marks 20**

a) Implement two circuits for a rising edge triggered D-Flip Flop at transistor level with an *Enable* input using multiplexer and clock gating approaches. Compare both of these approaches in terms of number of components used and speed of the circuits.

b) A tapped delay line is a shift register with a programmable number of stages which is used to insert a delay of different stages as per the requirement. This shift register could be designed using rising/falling edge triggered Flip-flops as well as Static Random Access Memory cells. Draw the schematics of both designs for a shift register with 0 to 15 stages delay and identify the control signals for the insertion of 7 stages delay.

Question 4:[CLO3-PLO3-C5] **Marks 20**

a) Design a circuit for the datapath of a digital computer at transistor level with minimum resources for the following function:

$$F(A,B,C,D) = \sum(0,2,4,5,9,11,12,15)$$

b) Design a circuit the above function using a Dynamic or Pseudo-nMOS NOR-gate based Programmable Logic Array at transistor level.

Question 5:[CLO3-PLO3-C5] **Marks 20**

a) Design 62-words of 2-bit four-way folded SRAM array along with its supporting circuitry at transistor level. Represent a cell of SRAM with a square box and draw all the required transistors and supporting circuitry for the design. Specifically identify how many decoders and multiplexers will be used and what are the sizes of these circuits.

b) Design a 64 KB NAND Flash memory which is divided into 2 planes: plane 0 & plane 1, where each plane contains 4 blocks of memory. Determine how many numbers of block per plane will be required and what will be number of pages per block are required. Moreover, determine what will be the size of each page.