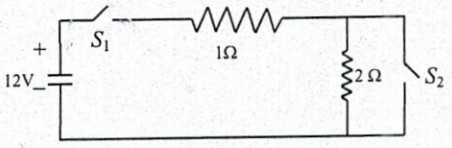
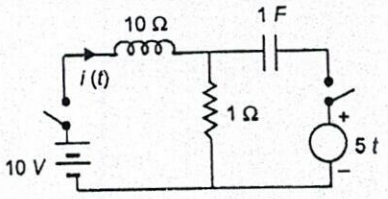
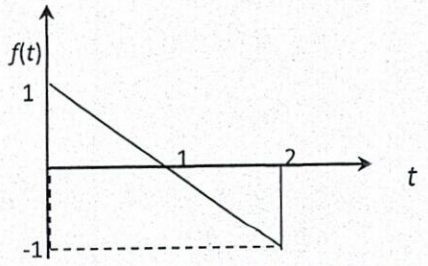
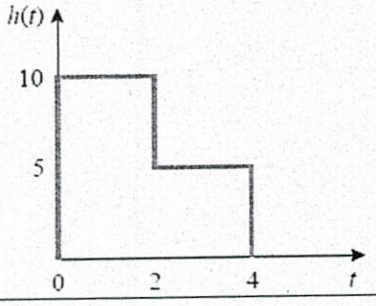
NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: ECC 301 Full Marks: 25

Course Name: Network Analysis & Synthesis Time: 90 Minutes

Instructions: Answer all the questions.
Materials to be supplied: Graph paper shall be supplied, if required.

Qn. No.	Body of the Question	Marks	Mapped CO
1 a) **OR**	The capacitor in the circuit, as shown below, is initially charged to 12V with S_1 and S_2 open. S_1 is closed at $t = 0$ and S_2 is closed at $t = 3$ sec. Draw the waveform of the capacitor current. 	5	CO1
1 b)	For the network shown in the Fig. determine the current i(t) when both the switch are closed simultaneously. Assume that the system is initially relaxed. 	5	CO1
2	Derive the Laplace transform of a full wave rectified sinusoidal waveform.	3	CO1
3 a) **OR**	Find the Laplace transform of the waveform shown in the Fig. 	3	CO1
3 b)	Find the Laplace transform of the function *h(t)* in Fig 	3	CO1

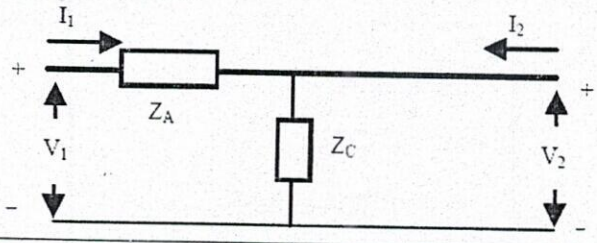
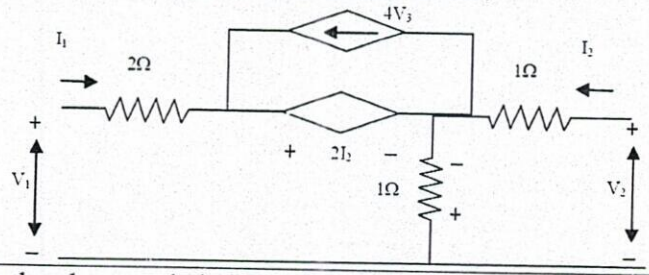
Course Outcomes

CO1. Applications of network theorems and Laplace transform in A.C. and D.C circuit analysis, time domain analysis of simple RLC circuits, transient analysis.

CO2. Graph Theorem, and characterization of two port networks and Z, Y, ABCD and h parameters, inter-relationships between the parameters.

CO3. Representation of two port network in terms of T & Π network, Bisection theorem and its applications, lattice network, image impedance, characteristic impedance and propagation function

CO4. Design of various types of attenuators and determination of insertion loss

4 a) **OR**	For the two port network shown below calculate the Transmission and Impedance parameters.  	6	CO2
4 b)	Find the Z parameters of the circuit shown below.  	6	CO2
5	Determine the characteristic impedance of a T section which at a certain frequency has Z_1= j600 Ω and Z_2= -j350Ω. Then find the characteristic impedance of the π section. Determine the Image and Iterative transfer impedance.	4	CO3
6	The arm for a lattice network are given by $R_a=R_0 tanh\ (\alpha/2)$ and $R_b=R_0 coth\ (\alpha/2)$, where α is expressed in Nepers. Using bisection principle design equations for T-section and π section attenuators.	4	CO4

R.D 125

NITDGP/BTECH/Reg/Odd/2023-24

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

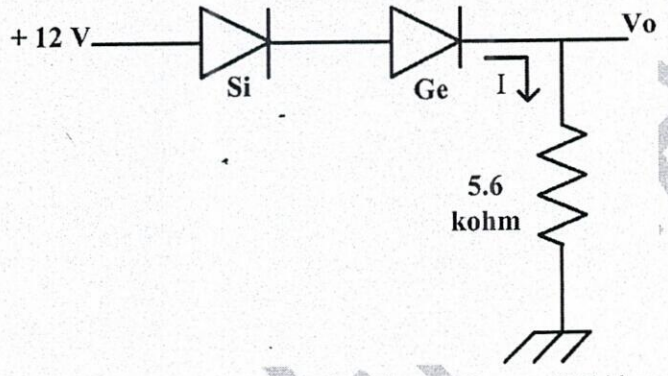
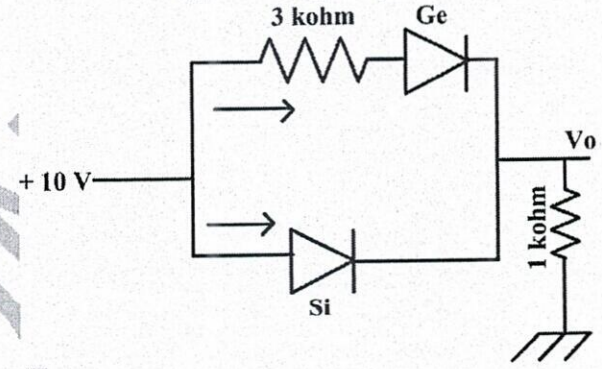
Course Code: ECC302 Full Marks: 25

Course Name: ELECTRONIC DEVICES AND CIRCUITS I Time: 90 Minutes

Question Paper No.: NITDGP/ECC302/ Date of Exam: 12/09/2023

Instructions: Answer all the questions.

Materials to be supplied: Graph paper shall be supplied, if required.

Question No.		Body of the Question	Marks	Mapped CO
1	a	If the width of the depletion region in case of no bias case is W, then how the width of the depletion region will change in case of i) forward bias and ii) reverse bias; state the reason?	4	CO1
	b	 Find V_0 and I, where V_{bi} for Si and Ge are 0.7 V and 0.2 V respectively.	2	
	c	 Find V_0 and current through Si and Ge branch?	3	
2	a	What are the different working modes of SCR, state the conditions of different working modes and draw the I-V characteristics of SCR.	1+1+1	CO1

Course Outcomes

CO1: Understanding the fundamental knowledge of analog devices and circuits

CO2: To become familiar with the design of much more complex electronic circuits with the help of those fundamentals.

	b	Why photodiode is not working in forward bias condition?	1	
	c	Explain the working of tunnel diode for positive bias with the help of the energy band diagram?	2	
3	a	In bridge rectifier circuit, secondary voltage is 60 V AC, R_L= 100Ω . Calculate I_{DC}, current through each diode, PIV, and O/P voltage?	5	CO2
	b	In bridge rectifier circuit turns ratio is 15:1, primary is connected to 230 V, 50 Hz and R_L= 5kΩ . Find the O/P DC voltage, PIV rating, and ripple frequency	5	

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: ECC 303 Full Marks: 25

Course Name: SIGNALS AND SYSTEMS Time: 90 Minutes

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	Calculate the fundamental time period and fundamental frequency of the following signal: $x(t) = \sin 6\pi t + \cos 5\pi t$	2.5	CO1
2	What is the condition for a signal to be Half Wave Symmetric? Comment whether or not the signal given in Figure 3 is half-wave symmetric.	2.5	CO1
3	Find the Average power, Average value, and RMS value of the signal Given in **Figure 3**.	2.5	CO1
4	If $x(t)$ is given as shown in **Figure 1**, draw the signal $y(t) = x(-2t + 1)$.	2.5	CO2
5	Find the even and odd components of the signal, as shown in **Figure 2**.	2.5	CO2
6	Mathematically prove that the unit rectangular signal is an energy signal.	2.5	CO2
7	If the average value of $x(t)$=8 units, then find the average value of $x(t) = \frac{2+x(2t+1)}{4}$.	2.5	CO3
8	Define Unit step, unit ramp, unit parabolic, and signum function.	2.5	CO2
9	Calculate $\int_{-\infty}^{\infty} e^{-2t}\partial(-2t + 1)dt$.	2.5	CO3
10	Write down the mathematical representation of the signal given in **Figure 4**.	2.5	CO3

Course Outcomes

CO1: To realize the difference between (i) continuous and discrete signals, (ii) analog and digital signals.
CO2: Understand mathematical techniques to solve problems involving convolution, filtering, modulation and sampling.
CO3: Ability to apply mathematical transforms for signals and systems analysis.
CO4: Analysis of stable LTI systems.
CO5: Practical realization of various forms of anti-aliasing filters.

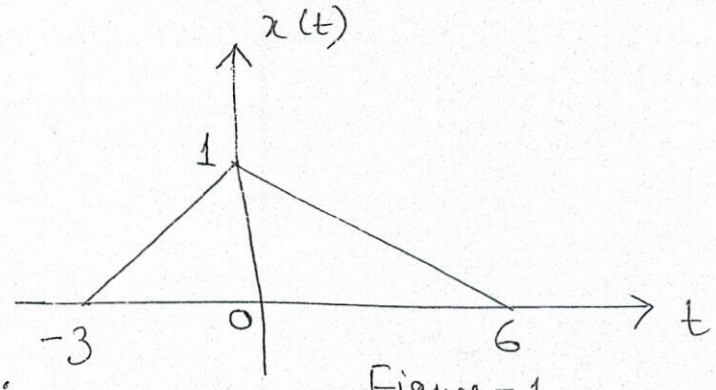


Figure – 1

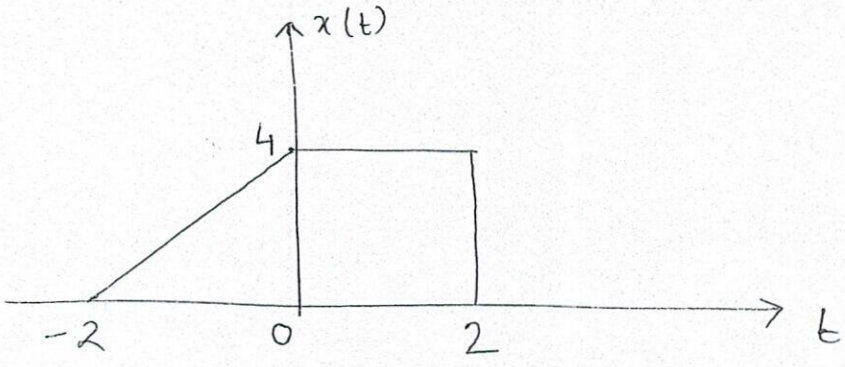


Figure – 2

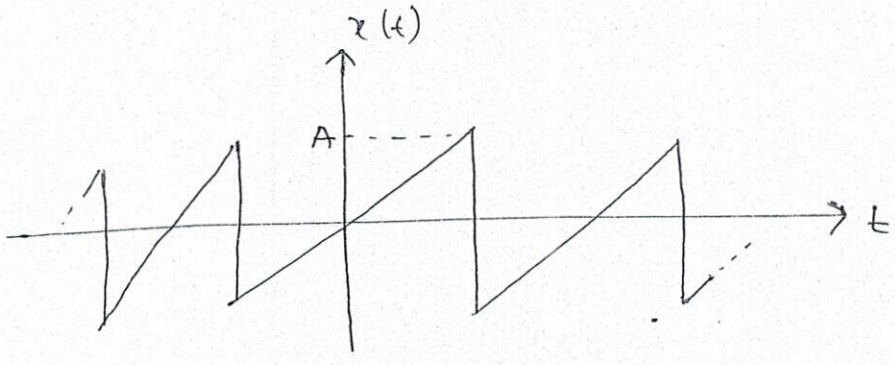


Figure – 3

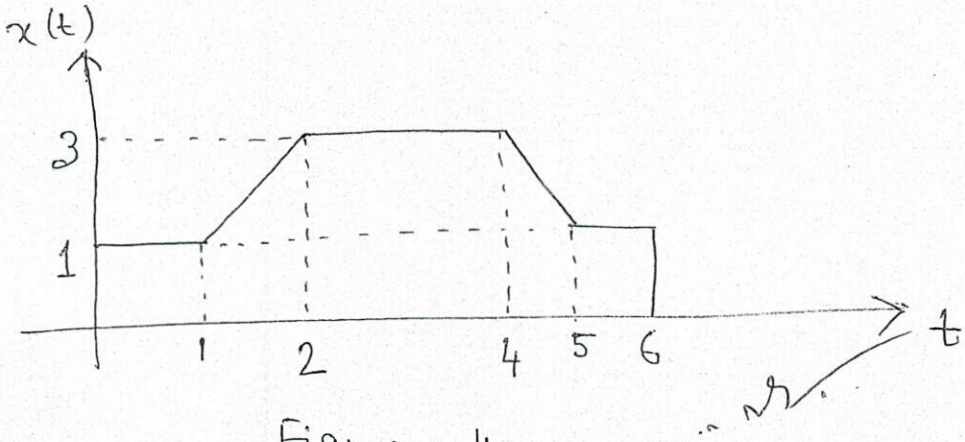


Figure – 4

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-2024

Course Code: ECC331 **Full Marks: 25**

Course Name: ANALOG ELECTRONICS **Time: 90 Minutes**

Instructions:

(I) Answer ALL Questions

(II) ALL PARTS OF A PARTICULAR QUESTION NUMBER MUST BE ANSWERED together, else marks will be deducted

Question No.	Part No.	Body of the Question	Marks	Mapped CO
1	A	Elucidate the following concepts w.r.t zener diodes: LINE and LOAD regulation.	2	CO1
	B	Design a zener diode limiter circuit comprising two zener diodes. Assume that the breakdown voltages of the zener diodes are 4 and 6 volts respectively. If the input $\mathbf{V_i}$ to the circuit is a sinusoid of amplitude ±10 volts, draw the waveform of the output voltage $\mathbf{V_o}$. Assume further that the cut-in voltage of the zener diodes is 0.6 volts, the forward resistance is 50 ohms and the zener resistance is 20 ohms.	3	CO2
	C	Design a difference amplifier using a single operational amplifier. Find out the differential and common mode gains. What are the drawbacks of the above design?	5	CO5
	D	To address the shortcomings in part 1(C) above, what modification can be suggested and how does it improve the circuit performance.	5	CO3
2	A	How are depletion and enhancement MOSFETs operationally different? With respect to the enhancement MOSFETs find out the output resistance.	5	CO1
3	A	Write a short note on **ANY one** of the following: (1) Schottky Barrier Diodes (2) Photodiodes	5	CO2

Course Outcomes

CO1: **Understanding** the fundamental knowledge of analog devices and circuits (*LEVEL 2 of Bloom's Taxonomy*)

CO2: **Familiarizing** with the design of complex electronic circuits with the help of these fundamentals (*LEVEL 2 of Bloom's Taxonomy*)

CO3: **Enriching** historical developments with facts that led to IC technology (*LEVEL 3 of Bloom's Taxonomy*)

CO4: **Acquainting** with the present day design tools using which one can synthesize and analyze the complex design problems (*LEVEL 1 of Bloom's Taxonomy*)

CO5: **Implementing** the devices and circuits as a basic building block of electrical communication and other areas and enhancing problem solving skills (*LEVEL 3 and above of Bloom's Taxonomy*)

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

Course Code: ECC 501 Full Marks: 25

Course Name: Digital Communication Time: 1 hr. 30 mins.

Instructions: Answer any five questions

Question No.	Body of the Question	Marks	Mapped CO
1 (a)	Prove the following relations: $I(X;Y) = H(X) - H(X\|Y)$ $H(X,Y) = H(X) + H(Y\|X)$	5	CO7
2 (a)	Define Mutual Information (MI) using concept of Relative Entropy. Obtain the MI for two independent random variables. Consider a Gaussian distribution $p(x)$ with mean and	2+3	CO7
(b)	variance (μ_1, σ_1^2) and another Gaussian distribution $q(x)$with mean and variance (μ_2, σ_2^2). Find the relative entropy between $p(x)$ and $q(x)$		
3	What is a Prefix code ? State and prove Shannon's Source coding theorem.	1+4	CO7
4	Let X and Y be binary random variable representing input and output of a binary symmetric channel with a flipping probability of 'p' and source probability 'q'. Find the mutual information I(X;Y) and plot it w.r.t 'q'. Hence obtain the capacity of this channel.	5	CO7
5	State Shannon's Channel Coding Theorem. Consider a Discrete memory less source (DMS) which emits equally likely binary symbols every T_s sec, using the above theorem establish $r \leq C$, where r is the code rate and C is the channel capacity.	3+2	CO7
6	(a) What is meant by uniform quantization ? What is the drawback of uniform quantization ? (b) Define nonuniform quantization. (c) Find the bit rate of a telephone grade voice signal used in PCM system.	2+1+2 = 5	CO1

Course Outcomes

CO1: **Acquire** idea about analog to digital conversion

CO7: understanding basic concept of information theory and coding

NITDGP/BTECH/Reg/Odd/2023-24

National Institute of Technology Durgapur

Odd Semester Mid-Term Examination 2023-24

Course Code:ECC-502. Full marks: 25.

Course Name: Microwave Engineering. Time: 90 Minutes.

All questions carry equal marks / Figures in the margin indicate full marks.

Answer any three (03) questions.

Instructions: Write down serially the attempted question number in the space provided on the top sheet of the answer script. Only attempted first three questions will be evaluated.

1. Derive the expressions for the electric and magnetic field intensities [Marks = 8⅓ , Co#1] in a rectangular waveguide for the transverse magnetic mode.

2. Derive the expressions for the electric and magnetic field intensities [Marks = 8⅓, Co#1] in a rectangular waveguide for the transverse electric mode.

3. Derive the expressions for the electric and magnetic field intensities [Marks = 8⅓, Co#1] in a cylindrical circular waveguide for the transverse magnetic mode.

4. Derive the expressions for the electric and magnetic field intensities [Marks = 8⅓, Co#1] in a cylindrical circular waveguide for the transverse electric mode.

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-term Examination, 2023-24

Course Code: ECC503 Full Marks: 25

Course Name: Microprocessors and Microcontrollers Time: 90 Minutes

Question Paper No.: NITDGP/ Date of Exam:

Section A

Answer the following questions [5×2]

Question No.	Body of the Question	Marks	Mapped CO
1	The memory address of the last location of 1K byte memory chip is given as FBFFH. Specify the starting address.	2	CO1
2	Discuss the functions of $DT/\overline{R}$ and $\overline{DEN}$ in 8086 µp.	2	CO1
3	Explain the function of tristate buffer used in the input and output of a memory register.	2	CO2
4	Explain the purpose of using status bits S3 and S4 in 8086 µp?.	2	CO3

5	After execution of ALP 1, evaluate the content of AX and the status of carry, parity, and auxiliary carry flag bits. **ALP 1: For question No. 5, Section A**
	MOV AX, 9AH
	MOV BX, 1278H
	ADD AX, BX
	HLT
		2	CO4

Section B

Answer the following questions [3×5]

Question No.	Body of the Question	Marks	Mapped CO
1	(a) Explain about the memory organization in 8086 microprocessor. (b) Describe the pipeline operation in 8086 architectures as performed by BIU and EU.	[3 + 2]	CO6
2	Draw and explain the timing diagram during the opcode fetch machine cycle of microprocessor 8086.	5	CO2
3	(a) Describe how the 20-bit physical address is generated in 8086. (b) The contents of different registers in 8086 are as given below. [AX] – 0300H, [BX] – 0500H, [CX] – 5050H, [DI] – 4040H, [BP] – 7070H, [SP] – 0600H, [CS] – 0100H, [DS] – 1000H, [SS] – 2000H, [ES] – 0300H, [IP] – 0900H. For the instruction "MOV AX, 50 [BX]", what will be the physical addresses for the instruction code and operand data?	[2+ 3]	CO3

Course Outcomes

CO # 1. **Describe** the fundamental operations and internal architectures of microprocessors and Microcontroller's as well as **identify** the peripherals to be used for the given microprocessor and Microcontroller based problems.

CO # 2. **Understand** the performance of Microprocessor (8085 & 8086) and Microcontroller based systems and **select** appropriate platform to meet specified requirements.

CO # 3. **Apply** the knowledge of Microprocessors, Microcontrollers and peripheral devices and demonstrate the programming proficiency using the various instruction codes of the target microprocessor and microcontroller.

CO # 4. **Analyze** different problems on microprocessors and microcontrollers and write appropriate assembly language programs.

CO # 5. **Evaluate** the machine codes to provide solutions to the real-world problems.

CO # 6. **Design** necessary I/O and Memory interfacing circuitry to communicate Microprocessor and Microcontroller with external devices.

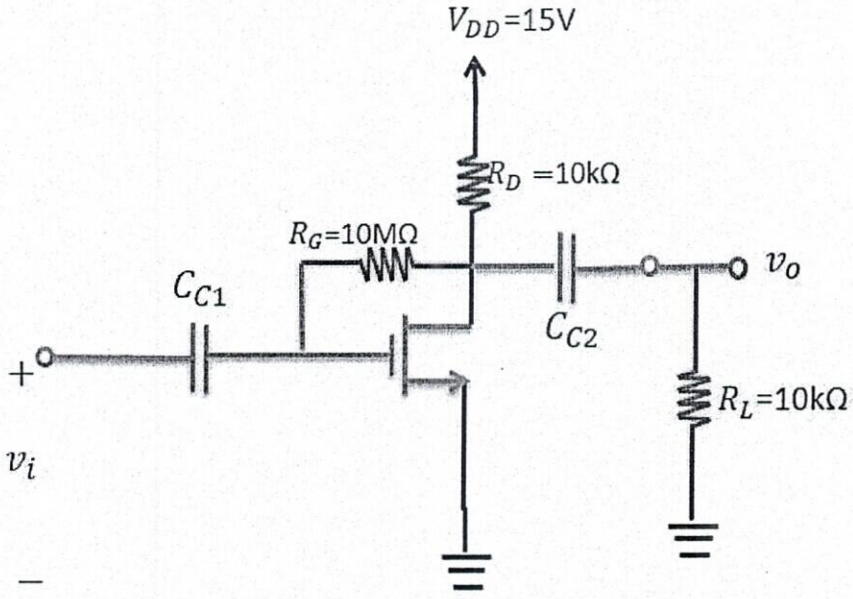
NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Odd Semester Mid-Term Examination, 2023-24

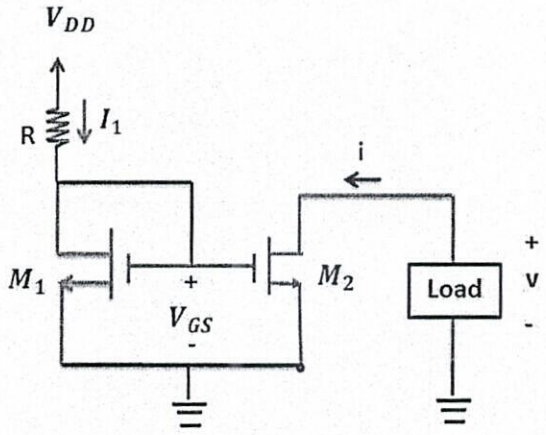
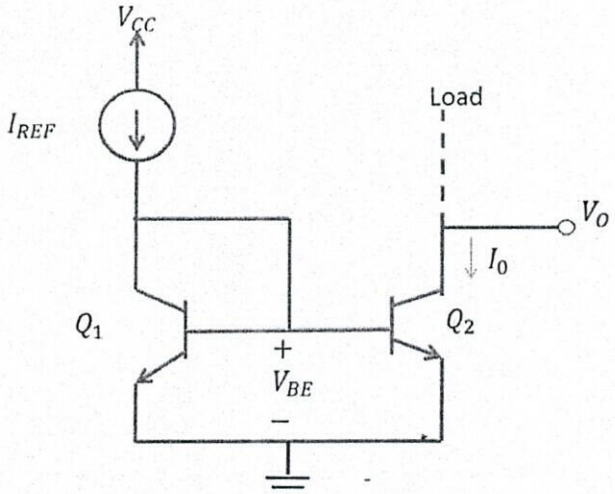
Course Code: ECC504 Full Marks: 25

Course Name: ELECTRONIC DEVICES AND CIRCUITS-II Time: 90 Minutes

Instructions: Answer all the questions.

Q. No.	Body of the Question	Marks	Mapped CO
1	With neat illustration, discuss the small signal hybrid π-model of a CE configuration and explain its small signal process parameters, current gain, voltage gain, and output resistance.	5	CO1
2	Fig. 1 shows a discrete common source MOSFET amplifier utilizing the drain-to-gate feedback biasing arrangement. Determine the circuit's small signal voltage gain, input resistance, and the largest allowable input signal. The transistor has V_t=1.5 V, kn'(W/L)=0.25mA/V^2, and V_A=50V. Assume the coupling capacitor is sufficiently large to act as short circuits at the signal frequencies of interest.  Fig. 1	5	CO1
3	Design a double MOS cascode current source with CS amplifier and determine its voltage gain, overall transconductance G_m, and Overall output resistance R_{out}.	5	CO5

Course Outcomes
CO1: Understand the fundamental principles of amplifiers and oscillators.
CO2: Able to design Power Amplifiers.
CO3: Become familiar with the design of wave shaping circuits.
CO4: Able to design regulated power supply circuits
CO5: To be able to make use of the recently developed electronic devices in solving the present day complex electronic systems.

4	Assume $V_{DD} = 5V$ and an identical device with $V_t = 1.0V$, k=0.8mA/V^2 as given in Fig. 2. Find out the value of R so that circuits gives i=100μA for v=V_{GS}. Here, assume λ=0 for simplicity.  Fig. 2	5	CO1, CO5
5	In the given widler current source (as shown in Fig. 3), Find out the relationship between I_o and I_{REF}.  Fig. 3	5	CO1, CO5