Date of showing evaluated answer books: one week after exam

No. of Printed Pages: 1 Subject Code: E E T 3 0 2

B.Tech EVEN SEMESTER EXAMINATION, 2021-22
Analog Integrated Circuit

Time: 2:30 Hrs. **Max. Marks: 50**

Note: 1. Attempt all questions.
2. All questions carry marks as shown against them.

			MM	
1.	(a)	Explain the role of substrate (body effect) in proper operation of MOS transistors. Give the equation defining the relationship between threshold voltage and substrate bias.	4	CO1
	(b)	An NMOS transistor fabricated in a certain process is found to have an intrinsic gain of 100V/V when operated at I_D of 100μA. Find the intrinsic gain for I_D = 25μA and I_D = 400μA.	4	CO3
2.	(a)	Consider a basic MOSFET current mirror with two transistors having equal channel lengths but with Q_2 having a width four times more than Q_1. If I_{REF} is 20μA and the transistors are operating at overdrive voltage of 0.3V, what I_o results?	4	CO1
	(b)	Analyze the frequency response of active loaded MOS differential pair, find expressions for f_{p1}, f_{p2} and f_z.	4	CO1
3.	(a)	Discuss the Successive Approximation Register type ADC. What do you mean by 'end of conversion' and settling time?	4	CO4
	(b)	Design a high pass filter to match following specifications: (a) Flat-flat response (b) roll off rate 24db/octave (c) Critical frequency 1200Hz. (d) pass band gain of 3	4	CO4
4.	(a)	Design and implement an inverting Schmitt trigger having UTP = 2.5V and LTP = 1.5V, V_{CC} = -V_{EE} = 12V, consider feedback fraction B = 0.01. Also draw hysteresis loop.	4	CO5
	(b)	Design a control circuit such that it generate a 20μsec of pulse at every positive going cycle of input signal defined as $v_i = 5sin2\pi1000t$.	4	CO5
5.	(a)	Design and implement a phase shifter such that it provides adjustable phase shift from 30^0 to 80^0 between input and output at frequency 1500Hz.	4	CO3
	(b)	Discuss the switched capacitor filter. Give advantages and disadvantages of switched capacitor filter over conventional analog filters.	4	CO2
6.	(a)	Draw the ideal and practical frequency response of Opamp.	2	CO3
	(b)	Draw the circuit diagram to determine *open loop* gain of Op-Amp IC741.	2	CO2
	(c)	Consider a sinusoid $v_i = 100x10^6sin(2\pi100t)$. Design a circuit to get negative half of the sinusoid.	2	CO5
	(d)	Design a pulse stretcher such that it stretch the pulse from 10μs to 30μs using IC555	2	CO5
	(e)	Draw the circuit diagram to convert 4-bit digital to analog convertor.	2	CO1

No. of Printed Pages: 1

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HARCOURT BUTLER TECHNICAL UNIVERSITY, KANPUR

Mid Semester Examination

Odd Semester III B.Tech EC (2021-22)

EET 355: ANTENNA AND WAVE PROPAGATION

Time: 1:30 Hours **Max. Marks: 30**

Note: 1. Attempt all questions.

2. All questions carry marks, as shown against them.

Q1. Define the terms Directivity, Radiation Resistance, Isotropic Antenna, HPBW, Radiation Power Density. Mention formulas if any. (5)

Q2. Define and state the necessary conditions a wave must have to possess linear, circular and elliptical polarization. (5)

Q3. A resonant half-wavelength dipole is made out of copper ($\sigma = 5.7 \times 10^7$ S/m) wire. Determine the conduction-dielectric (radiation) efficiency of the dipole antenna at $f = 100$ MHz if the radius of the wire b is $3 \times 10^{-4}\lambda$, and the radiation resistance of the $\lambda/2$ dipole is 73 ohms. (6)

Q4. Derive the relationship between Maximum Directivity and Maximum Effective area in terms of D_t, D_r, A_t, A_r. Assume transmitting antenna is isotropic. (Show all the steps) (4)

Q5. The electric field of a linearly polarized electromagnetic wave given by $\mathbf{E}_i = \hat{\mathbf{a}}_x E_0(x,y)\, e^{-jkz}$ is incident upon a linearly polarized antenna whose electric-field polarization is expressed as $\mathbf{E}_a \simeq (\hat{\mathbf{a}}_x + \hat{\mathbf{a}}_y)\, E(r, \theta, \phi)$. Find the polarization loss factor (PLF) (5)

Q6. Explain the field regions Far Field and Near Field regions in detail along with the relationship between dimension of antenna D and field region distance R. (5)

I Mid Sem. Exam 2021-22 (Odd)
Class: Third Year B. Tech, **Branch**: ET
Subject: VLSI Technology, **EET-359**

Time: 1.5 Hr. M.M. 30

NOTE: Attempt all questions.

Q1. Explain CZ method for obtaining Si ingot. What do you mean b segregation coefficient and how it affects the impurities? **[3+2]**

Q2. What do you mean by Epitaxy? Explain and compare the different reactors used for Vapour Phase Epitaxy (VPE). **[2+3]**

Q3. What do you mean by photolithography? Name two Positive and Negative photo resist. **[3+2]**

Q4. Explain the difference between the variations in threshold voltage for ideal and practical MOSFETs. What are the factors affecting it? **[5]**

Q5. What do you mean by etching? Explain anisotropy for wet and dry etching. **[5]**

Q6. Calculate the threshold voltage of MOS capacitor having following parameters: $N_A=1.45\times10^{16}cm^{-3}$, T=300 °K, $t_o=0.2\mu m$. **[5]**

discuss about its role in a microprocessor based system

MIDSEMESTER EXAMINATION 2021-22-I

III ET

MICROPROCESSORS (EET-357)

Max. Marks : 30 **Duration: 1.5 Hrs**

Note: Attempt all questions.

Q.1 Explain memory read operation of 8085 with the help of suitable example, architecture and timing diagram.

[10]

Q.2 Interface 8255 with 8086 to work as 8 bit I/O port. Initialize port A as input port, port B as output port. Port A address should be 0720H. Write a program to sense switch positions SW0-SW7 connected at port A. The sensed pattern is to be displayed at port B to which 8 LED's are connected. Draw the schematic and the flow chart of the program.

[10]

Q.3 a) Draw and explain internal block diagram of Programmable Timer Counter 8253. Also discuss about its role in a microprocessor based system.

[5]

b) Write a comparison between a microprocessor and a microcontroller

[5]

EET 353 Analog Communication
ETD, HBTU Kanpur, Odd 2021-22

November 29th, 2021

Mid Semester Examination

Total Marks: 15

Time: 90 Minutes

NOTE: *Attempt all FOUR questions in the question paper. Each question carries equal marks and marks are divided equally in all parts of a question. Unless stated otherwise, answers must be derived or explained, not just simply written down. Assume any data if necessary.*

1. **(i)** A train of rectangular pulses, making excursions from 0 to 1 Volt: have a duration of 2 μs and are separated by intervals of 10 μs. Assume that the centre of one pulse is located at t=0. Write the exponential Fourier Series for this pulse train and plot the spectral amplitudes as a function of frequency. Include at least 10 spectral components on each side of $f = 0$ and draw also the envelope of these spectral amplitudes.
   (ii) Find the Cross Correlation of the functions Sin ωt and Cos ωt.

2. **(i)** The signal $v(t) = (1 + 0.1 \cos \omega_1 t + 0.1 \cos 2\omega_1 t) \cos \omega_c t$ is detected by a square-law detector, $v_0 = 2 v^2$. Plot the amplitude -frequency characteristics of $v_0(t)$.
   (ii) A baseband signal, band limited to the frequency range 300 Hz to 3000 Hz, is to be superimposed on a carrier of frequency of 40 MHz as a single-sideband modulation using the filter method. Assume that band pass filters are available which will provide 40 dB of attenuation in a frequency interval which is about 1 percent of the filter center frequency. Draw a block diagram of a suitable system. At each point in the system draw plots indicating the spectral range occupied by the signal present there.

3. **(i)** The frequency of a laboratory oscillator is varied back and forth extremely slowly and at a uniform rate between the frequencies of 99 KHz and 101 KHz. The amplitude of the oscillator output is constant at 2 volts. Make a plot of the two-sided power spectral density of the oscillator output waveform.
   (ii) Describe with sufficient mathematics, how frequency discriminator does the demodulation of FM wave.

4. **(i)** A coin is tossed until a head appears. Let T be the random variable which identifies the number of tosses t required for the appearance of this first head. Make a plot of the probability $P(T \leq t)$ as a function of t up to $t = 5$.
   (ii) A pulse train consists of rectangular pulses having an amplitude of 2 volts and widths which are either 1 μs or 2 μs with equal probability. The mean time between pulses is 5 μs. Find the power spectral density of the pulse train.

III B.Tech (ET) Mid Sem Exam -2021

Analog Integrated Circuit (EET 302)

MM: 30 Time: 1:30hrs

Attempt all questions.

Q.1 (a) A 0.18-μm fabrication process is specified to have t_{ox}= *4nm*, μ_n = 450 cm²/V•s, and Vt = 0.5V. Find the value of the process transconductance parameter k_n'. For a MOSFET with minimum length fabricated in this process, find the required value of W so that the device exhibits a channel resistance of 1 K at v_{GS}= 1V. [given $\varepsilon_{ox} = 3.45\text{x}10^{-11}$F/m] 5

(b) An NMOS transistor having Vt = 1 V is operated in the triode region with v_{DS} small. With V_{GS} = 1.5 V, it is found to have a resistance r_{DS} of 1 kΩ. What value of V_{GS} is required to obtain r_{DS} = 200Ω ? Find the corresponding resistance values obtained with a device having twice the value of W. 5

Q.2 (a) For V_{DD}=1.8V and using I_{REF} =100μA it is required to design the basic MOSFET current mirror to obtain an output current whose nominal value is 100 μA. Find R if Q_1 and Q_2 are matched with channel lengths of 0.5 μm, channel widths of 4 μm, Vt = 0.5V and k_n'= 400μA/V² What is the lowest possible value of V_o? Assuming that for this process technology the Early voltage V'_A = 10V/μm, find the output resistance of the current source. Also, find the change in output current resulting from a +0.5-V change in V_o. 5

(b) Design and implement a 5kHz free running oscillator using IC555 having duty cycle of 30%. Also draw the output and capacitor charging and discharging waveforms. 5

Q.3(a) Calculate the approximate output voltage in Fig. 3. What is the power dissipation in the pass transistor? What is the approximate efficiency in? 5

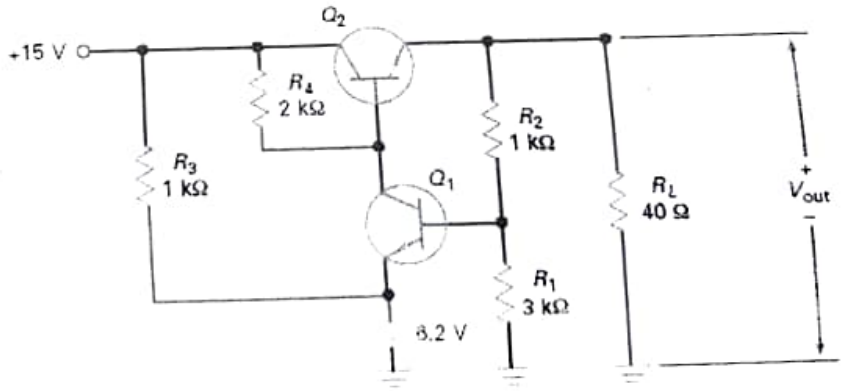

Fig-3

(b) Consider a sine wave, $sin2\pi 100t$. Generate a trigger pulse a when sine wave is at 50% of its peak value. Design and implement a system such that the generated trigger can switch ON a controller for 2 seconds. 5

Mid –Semester (Odd Semester) Examination 2021-22
OPERATIONS RESEARCH (BMA- 341)
III B.Tech. (CS/IT/ET/ME/CE/EE)

Time: 1.5 hr. **MM: 30**

Note: Attempt all the questions:

Q.1 Explain all integer programming problem. Describe Gomory's constraint and explain its use in the solution of the problem. **(5)**

Q.2 Determine the initial basic feasible solution to the following transportation problem by using Vogel's Approximation Method: **(5)**

		Destination				
		D_1	D_2	D_3	D_4	Supply
Origin	O_1	6	1	9	3	70
	O_2	11	5	2	8	55
	O_3	10	12	4	7	70
	Demand	85	35	50	45	

Q.3 A captain of a cricket team has to allot five middle order batting positions to five batsmen. The average runs scored by each batsman at these positions are given in the table. **(5)**

Batting position →

Batsman ↓	III	IV	V	VI	VII
A	40	40	35	25	50
B	42	30	16	25	27
C	50	48	40	60	50
D	20	19	20	18	25
E	58	60	59	55	53

Make the assignment so that the expected total average runs scored by these batsmen are maximum. **(5)**

Q.4 In a metal shop two articles A and B are produced. The article A takes 2 minutes to stamp, 3 minutes to form and 2 minutes to paint. The article B takes 4 minutes to stamp, 1 minute to form and 1.6 minutes to paint. The profit margins on products A and B are Rs. 6 and Rs. 9 respectively. The time available per week on each process is 50 hrs. (3000) minutes. How many products of type A and B should be produced so as to maximize profit? Find also the maximum profit by using graphical method.

Q.5 Use Big- M method to solve the following LPP: **(5)**

Minimize $Z = 12\,x_1 + 20\,x_2$

Subject to: $6x_1 + 8x_2 \geq 100$, $7x_1 + 12\,x_2 \geq 120$, and $x_1, x_2 \geq 0$

Q.6 What is degeneracy? Discuss a method to resolve degeneracy in LPP. **(5)**

OR

Discuss the main characteristics of OR with suitable examples.

A B
2 4
3 1
2 1.6

2 6 9

$2x_1 + 3x_2 + 2x_3$
$4x_1 + 1x_2 + 1.6x_3$

Roll No.....

Date of showing evaluated answer sheets: 29/04/2022
No. of printed pages:04

HARCOURT BUTLER TECHNICAL UNIVERSITY

End-Semester Examination

Odd Semester (V/B. Tech.), 2021-22

(IT,CS, ME, EE, ET, CE)

BMA-341/351: Operations Research

Time: 2.30 Hrs. **Max. Marks: 50**

INSTRUCTIONS:

i) Answer all the questions. ii) All questions carry marks, as shown against them.

iii) Mathematical symbols have their usual meanings.

Course outcomes (CO):

1.Understand and solve linear programming problems.

2. Formulate and solve Transportations models, Assignment models and integer linear programming problems.

3. Formulate and solve sequencing and scheduling models.

4. Formulate and solve Replacement and inventory models.

5. Learn and use Dynamic programming and Genetic Algorithms

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1. (a) Two products P_1 and P_2 are to be manufactured by a firm. Profits on P_1 and P_2 are Rs.30 and 20 respectively. The products are to be processed on two machines, i.e., first on milling machine and other on surface grinder. The capacities and the time required to produce a unit are as follows: CO1 5

	P_1	P_2	capacity
Milling machine	3 hours	1 hour	1500 man hrs./month
Surface grinder	1 hour	1 hour	1000 man hrs./month

Use simplex method to find the no. of products of type P_1 and P_2 to get maximum profit.

(b) Solve the following Linear programming problem by graphical method: 2.5

$$\text{Min. } Z = 3x_1 + 5x_2$$

$$\text{subject to } -3x_1 + 4x_2 \le 12$$

$$2x_1 - x_2 \ge -2$$

$$2x_1 + 3x_2 \ge 12$$

$$x_1 \le 4$$

$$x_2 \ge 2$$

$$\text{and } x_1, x_2 \ge 0$$

(c) Explain the duality theory of the Linear Programming and find the dual of the following LPP: 2.5

$$\text{Min. } Z = x_1 + x_2 + x_3$$

$$\text{subject to } x_1 - 3x_2 + 4x_3 = 5$$

$$x_1 - 2x_2 \le 3$$

$$2x_2 - x_3 \ge 4$$

$$\text{and } x_1, x_2 \ge 0 \text{ and } x_3 \text{ is unrestricted}$$

OR

Describe the computational procedure of Two phase method.

2. (a) State the transportation problem in general terms and find the initial basic feasible solution of the following T.P by using Lowest Cost Entry Method then check the optimality of the solution by MODI method. CO2 5

Market

		M_1	M_2	M_3	M_4	Capacity
Origins	O_1	8	10	7	6	50
	O_2	12	9	4	7	40
	O_3	9	11	10	8	30
Requirement		25	32	40	23	

(b) There are five machines and five operators. Assign one operator to one machine so that overall payment is minimum and find the total minimum cost. 2.5

Jobs → Machines ↓	J_1	J_2	J_3	J_4	J_5
M_1	1	3	2	3	6
M_2	2	4	3	1	5
M_3	5	6	3	4	6
M_4	3	1	4	2	2
M_5	1	5	6	5	4

(c) Explain all integer programming problem. Describe Gomory's Cutting Plane method to solve the IPP by a suitable example. 2.5

OR

Describe the Branch-and-Bound technique to solve the integer programming problem with suitable example.

3. (a) What is CPM? What are the essential steps in CPM for project planning? A project consists of nine activities with the following relevant information: CO3 5

Activity	Estimated duration (days)		
	Optimistic	Most likely	Pessimistic
1-2	2	5	14
1-6	2	5	8
2-3	5	11	29
2-4	1	4	7
3-5	5	11	17
4-5	2	5	14
6-7	3	9	27
5-8	2	2	8
7-8	7	13	31

(i) Draw the PERT network and calculate the expected project completion time

(ii) Find the expected time for each activity and critical path.

(iii) Calculate EST, LST, EFT, LFT and floats.

(b) What is a sequencing problem? Describe the Johnson's algorithm to solve the problem of processing n jobs through two machines. 5
Determine the optimal sequence of jobs that minimizes the total elapsed time and the total elapsed time based on the following information:

Job→ Machines	1	2	3	4	5	6	7
M_1	3	8	7	4	9	8	7
M_2	4	3	2	5	1	4	3
M_3	6	7	5	11	5	6	12

4. (a) Find the best replacement policy of a machine when its maintenance cost is given by a function increasing with time and money value is constant. The cost of a machine is Rs.6100, its scrap value is only Rs. 100. The maintenance cost is given as follows: CO4 5

Years	1	2	3	4	5	6	7	8
Maintenance cost	100	250	400	600	900	1250	1600	2000

Determine the optimum period for replacement of the machine.

(b) Derive the formula for economic order quantity when stock replenishment is not instantaneous (gradual replenishment or finite replenishment). 2.5

(c) ABC manufacturing company needs ball bearings of worth Rs. 28,800 per year. The cost of placing an order is Rs. 48 and inventory carrying cost as a percentage of average inventory investment is 12%. 2.5

(i) Determine the value of each assignment.

(ii) No. of orders per year.

OR

Derive the EOQ formula for the inventory model with infinite rate of replenishment and without shortage.

5. (a) Use the principle of optimality to find the maximum value of $Z = b_1 x_1 + b_2 x_2 + \ldots b_n x_n$ when $x_1 + x_2 + x_3 + \ldots + x_n = C$ and $x_1, x_2, x_3, \ldots x_n \geq 0$ CO5 5

(b) Explain dynamic programming problem and describe the basic features and characteristics of dynamic programming problems. 5

Date of showing evaluated answer books: After one weak from the date of exam……

No. of Printed Pages: …02….. Roll No. ……

HARCOURT BUTLER TECHNICAL UNIVERSITY, KANPUR

B.Tech.

End Semester Examination

Odd Semester (V), 2021-22

EET-357….: MICROPROCESSORS

Time: 2:30 Hours **Max. Marks: 50**

Note: 1. Attempt all questions. All questions carry marks, as shown against them.
2. Q.No.6 is from the lab component of the subject.

	Related CO: [Course outcome]	Marks
Q.No. 1:		**8**
(a) Write an assembly language program based on 8085 to sort the 10 given Numbers from memory location 2500H in descending order.	2	4
(b) Explain the operation of following instructions of 8085. Also mention the addressing modes of each instruction		
(i) DCR M		4
(ii) STA 2000H		
(iii) LXI H, 1234H		
(iv) NOP		
Q.No. 2:		**8**
(a) Describe the difference between the minimum mode and maximum mode operation of 8086 Microprocessor.	3	4
(b) Design a programmable timer using 8254 and 8086. Interface 8254 at an address of 0010H for counter 0 and write an assembly language program to generate a square wave of 2 ms. Draw the schematic and the flow chart. The 8086 and 8254 are operating at 6 MHz and 1.5 MHz respectively.		4
Q.No. 3:		**8**
(a) What are the uses of flags? Explain the use of each flag of 8086 with the help of suitable instructions.	1	4
(b) Suppose DS = 0200H, BX = 0300H, DI = 4000H, SI = 2000H. Determine the memory address accessed by each of the following Instructions:		4
(i) MOV AL, [1234H]		
(ii) MOV AX, [BX]		
(iii) MOV AX, [BX + DI]		
(iv) MOV CX, [BX + SI]		
Q.No. 4:		**8**
(a) What is the difference between:		
(i) Bit and Byte addressable registers?	4	4
(ii) Bit and Byte addressable instructions?		

Explain with the help of suitable instructions of 8051 Microcontroller. | | 4

Q.No. 5:		**8**
(a)	Draw and explain the Load and Store architecture of ARM7	4
(b)	What are the advantages of RISC machine?	4
Q.No. 6:		**10**

Explain the application of any Microprocessor or Microcontroller with the help of: | | 10

(i) Problem Statement
(ii) Schematic of the solution
(iii) Flow chart of the solution
(iv) Program of the solution
(v) Tentative results of the solution

Date of showing evaluated answer books: Seven days after examination

No. of Printed Pages: 02

Roll No. .....

HARCOURT BUTLER TECHNICAL UNIVERSITY, KANPUR

End Semester Examination
Odd Semester (3rd year B. Tech), 2021-22
EET-355: Antenna and wave propagation

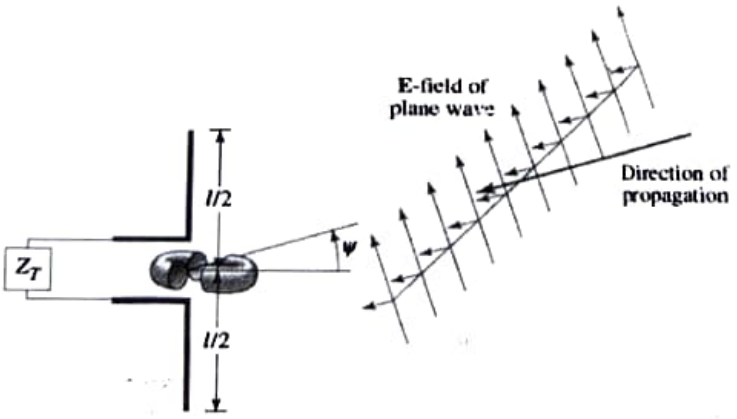
Time: 2:30 Hours **Max. Marks: 50**

Note: *1. Attempt all questions.*
2. All questions carry marks, as shown against them.
3. Total 5 Questions are there.
4. All symbols have their usual meaning.

Course Outcomes (CO) in statement form:

1. Understand the properties and various types of antennas.
2. Analyze the properties of different types of antennas and their design.
3. Operate antenna design software tools and come up with the design of the antenna of required specifications.
4. Apply the concepts for understanding different antenna arrays.
5. Have the knowledge of different modes of radio wave propagation and various effecting parameters

	Related CO	Marks
Q.No. 1. Attempt all the questions:		10
(a) Explain Friis Transmission Equation in detail.	1	(5+5)
(b) A uniform plane wave is incident upon a very short lossless dipole ($l<<\lambda$), as shown in the given below figure, Find the maximum effective area assuming that the radiation resistance of the dipole is $Rr = 80(\pi l/\lambda)$, and the incident field is linearly polarized along the axis of the dipole.	1,2	
Q.No. 2 Attempt all the questions:		10
(a) Write short note on: (Sketch where needed)	5,3	(5+5)
(i) Maximum usable frequency (MUF)		
(ii) Antenna Efficiency		
(b) Derive an expression for field strength generated in tropospheric region at the receiver antenna where distance between transmitter and receiver antenna is d. (Assume: Earth is flat in nature and initial field strength is E_0)	2,5	



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Q.No. 3: Attempt all the questions:		
(a) Draw total field pattern of End fire array antenna with net sketch of HPBW and FNBW.	4	10 (5+5)
(b) A lossless resonant half-wavelength dipole antenna, with input impedance of 73 ohms, is connected to a transmission line whose characteristic impedance is 50 ohms. Assuming that the pattern of the antenna is given approximately by $U = B_0 \sin 3\theta$ Find the maximum absolute gain of this antenna.	2,3	
Q.No. 4 Attempt all the questions:		10
(a) The radiation pattern of antenna in spherical coordinate is $F(\theta)=\cos^5\theta, 0 \le \theta \le \frac{\pi}{2}$ Find the directivity of antenna in dB.	2,4	(5+5)
(b) What do you mean by Global positioning system; also explain IRNSS and NAVSTAR GPS system.	2,4,5	
Q.No. 5 : Attempt all the questions:		
(a) Write short notes on below: (i) Virtual Height (ii) Skip distance	2,5	10 (5+5)
(b) A transmitting antenna of 100 m height radiates 40 watt power at 100 MHz uniformly in an azimuth plane. Calculate the maximum LOS and strength of the received signal at 16 m high receiving antenna at a distance of 10 km, At what distance the signal strength would reduce to 1 mV/m	2,3,5	

**********END**********

Tentative Date of showing evaluated answer books: Seventh day from the date of end of examination

No. of Printed Pages: 02

Roll No. .....

HARCOURT BUTLER TECHNICAL UNIVERSITY, KANPUR
III B. TECH. (ET) ODD SEMESTER EXAMINATION, SESSION 2021-22

EET 353 ANALOG COMMUNICATION

Time: 2.5 Hrs. **Max. Marks: 50**

NOTE: This question paper contains six questions in total (first five questions from theory component and the last one question from lab component). **Attempt all six questions.** Each question carries marks as shown against them. Unless stated otherwise, marks in a question are equally divided in all its parts and further divided equally in all subparts of a part. Assume any data if necessary. Unless stated otherwise, answers must be derived or explained, not just simply written down. You can support your answers with necessary figures and plots. Please show all your steps and clearly identify your final answer to get full credit. **Attempt all parts of a question at one place.**

COURSE OUTCOMES:
Upon Completion of the course the students will be able to:
1. *Understand the basics of communication systems, basic resources and their tradeoff, frequency domain analysis and need & types of modulation*
2. *Do comparative study of various schemes for Amplitude modulation and demodulation for different applications*
3. *Do comparative study of different types of Angle modulation and various schemes of modulation and demodulation*
4. *Do the probabilistic analysis of random processes and their frequency domain behavior and to understand the various noise types and noise models*
5. *Analyze the comparative noise behavior of AM-FM-PM systems and to understand the noise compensation schemes*

Q. N.	Part No.	Question	CO	Marks
1.	(a)	(i) What are the important parameters in evaluating the performance of communication systems?	1	4
		(ii) When a set of mutually orthogonal functions is said to be Closed or Complete over an interval?		
	(b)	(i) Find the Hilbert transform of the signal $m(t) = \cos(\omega_1 t)\cos(\omega_2 t)$. Assume $\omega_1 > \omega_2$.	1	4
		(ii) Show that the Hilbert transform of an even signal is odd and the Hilbert transform of an odd signal is even..		
2.	(a)	(i) Explain the major advantage of using envelope detection as demodulation scheme.	2	4
		(ii) Explain why SSBSC modulation is better suited for voice signals as compared to other types of message signals.		
	(b)	The message signal $m(t) = 2\cos 400t + 4\sin(500t + \pi/3)$ modulates the carrier signal $c(t) = A\cos(8000\pi t)$, using DSB amplitude modulation. Find the time domain and frequency domain representation of the modulated signal and plot the spectrum of the modulated signal. What is the power content of the modulated signal?	2	4

3. **(a)** The message signal $m(t) = 10\ \text{Sinc}\ (400t)$ frequency modulates the carrier $c(t) = 100 \cos 2\pi f_c t$. The modulation index is 6. 3 4
(i) Write an expression for the modulated signal u(t)?
(ii) What is the maximum frequency deviation of the modulated signal?
(iii) What is the power content of the modulated signal?
(iv) Find the bandwidth of the modulated signal.

(b) **(i)** List the advantages and applications of (I) Narrowband FM and (II) Wideband FM 3 4
(ii) List the advantages and limitations of FM over AM

4. **(a)** **(i)** If the pdf of random variable X is given as $\lambda \exp(-\lambda x)$, Find E(X) and $E(X^2)$. 4 4
(ii) Let X_1, X_2 be two iid random variables with densities given as $f_{X1}(x) = f_{X2}(x) = \lambda \exp(-\lambda x)$, $x \geq 0$. Determine the density of $Y = X_1 + X_2$ for $y \geq 0$.

(b) A pulse train consists of rectangular pulses having an amplitude of 2 volts and widths which are either 1 μs or 2 μs with equal probability. The mean time between pulses is 5 μs. Find the power spectral density of the pulse train. 4 4

5. **(a)** Consider a white Gaussian noise of zero mean and Power spectral density $N_0/2$, passes through an ideal band-pass filter of pass-band magnitude response equal to one, mid-band frequency f_c, and bandwidth 2B. Find and plot the Power spectral density characteristic of the filtered noise n(t). Also determine the autocorrelation function of n(t) and its in-phase and quadrature components. 5 4

(b) **(i)** What is Pre-emphasis and why it is used? Why de-emphasis must also be used with pre-emphasis? Describe 75 μs emphasis curves. 5 4
(ii) For a tone signal $m(t) = \cos(\omega_m t)$, find the minimum value of FM modulation index β such that the FoM of FM exceeds that of the DSBSC modulation.

6. **(a)** Write a *MATLAB*® code to perform instantaneous sampling of a sinusoidal signal. 1 2

(b) What conditions should be confirmed by an envelope detector to perform demodulation satisfactorily? 2 2

(c) What is the ideal bandwidth of an FM modulated wave? Discuss the Carson's Rule to calculate the approximate bandwidth of an FM signal. 3 2

(d) State the basic reason, frequency range of dominance, rate of increment in dB/octave for the transit time noise. 4 2

(e) Draw the noise power spectrum at demodulator output over the message bandwidth in (i) PM (ii) FM 5 2