NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

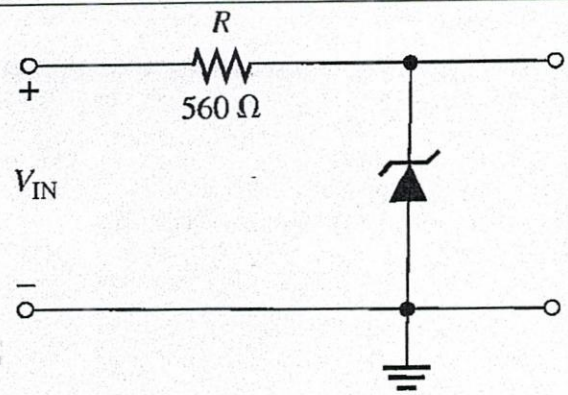
Even Semester Mid-term Examination, 2021-22

Course Code: ECC01
Course Name: Basic Electronics
Question Paper No.: NITDGP/

Full Marks: 25
Time: 90 Minutes
Date of Exam: 02/06/2022

Section A

Answer the following questions [5×2]

Question No.	Body of the Question	Marks	Mapped CO
1	Briefly discuss about the conductivity of intrinsic semiconductor at temperature at 0^0K and 300^0K respectively.	2	CO1
2	A Si p-n junction has acceptor concentration of $10^{18}/cm^3$ and donor concentrations of 5 x $10^5/cm^3$. Calculate the built-in-potential and total depletion width.	2	CO2
3	A sinusoidal voltage has been applied to the input of a half wave rectifier. The average output voltage has been found to be 2V across the load resistance 2KΩ. Find the peak value of the input voltage and diode current, considering the ideal diode.	2	CO2
4	Detemine the minimum input voltage required for regulation to be established in the regulator circuit in Figure 1. Assume an ideal Zener diode with I_{ZK} = 1.5 mA and V_Z = 14 V.  *Figure 1*	2	CO3
5	With constructional diagram of a planner BJT, draw and explain its relative doping profile at different regions.	2	CO2, CO4

Section B

Answer the following questions [3×5]

Question No.	Body of the Question	Marks	Mapped CO
1	A silicon diode has a saturation current of 0.1 pA at 20^0C. Find its current when it is forward biased by 0.55 V. Find the current in the same diode when the temperature rises to 100^0C. Calculate the static and the dynamic resistances of the diode at 300 K.	2+2+1	CO1

Course Outcomes
CO1: Knowledge of Semiconductor physics and devices.
CO2: Have an in depth understanding of basic electronic circuit, construction, operation.
CO3: Ability to make proper designs using these circuit elements for different applications.
CO4: Learn to analyze the circuits and to find out relation between input and output.

2	In a center-tapped full wave rectifier using silicon diode, the voltage across the end-to-end secondary terminals is 60 V rms. The connected load resistance is 100Ω. Find (a) The average value of the voltage across R_L. (b) DC power dissipated by R_L. (c) ac current in R_L. (d) rms current drawn from the secondary. (e) The minimum PIV rating required for each diode.	[1+1+1+ 1+1]	CO2, CO3
3	(a) With a neat circuit diagram of a CB transistor configuration discuss about amplification operation. (b) Derive the relationship between α and β of transistor. (c) An n-p-n transistor with α = 0.98 is operating in CE configuration. If the base current (I_B) is 100 μA, calculate collector current, I_C.	[2+1½+1½]	CO2, CO4

Some useful constants:

1. Intrinsic carrier concentration of Si at room temperature is 1.5×10^{10} cm^{-3}.
2. 1kT at room temperature = 0.0256 eV
3. Relative dielectric constant of Si = 11.8
4. Electronic charge = 1.6×10^{-19} Coulomb
5. Mobility of holes in Si at room temperature = 500cm^2/V-s
6. Mobility of electrons in Si at room temperature = 1300cm^2/V-s
7. $\varepsilon_0 = 8.85 \times 10^{-12}$ Farad/meter

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: ECC401 **Full Marks: 30**

Course Name: Analog Communication **Time: 90 Minutes**

Question Paper No.: NITDGP/ECC401/1 Date of Exam: 25 / 4 /2022

Instructions: Answer all the questions

Question No.	Body of the question	Marks	Mapped CO
1	What is ganged tuning? Explain with suitable diagrams.	3	4
2	What is image frequency?	2	3
3	What is aperture effect? How can you reduce it?	3	3
4	Describe the method of generating PWM signal.	3	3
5	The probability of error in transmission of digital data through a noisy channel is 0.001. (a)What is the probability that out of 10 transmissions 9 are correct? (b) What is the probability that more than one are erroneous out of 100 transmissions?	2	5
6	Define WSS, Correlation co-efficient, White noise.	3	5
7	What is band pass limiter? What is staggered tuning?	2	4
8	Find the SNR in a base band system with a bandwidth of 5 KHz and with a two sided PSD of 10^{-14} W/Hz. The transmitter power is one kilowatt and the channel attenuation is 10^{-12}.	3	6
9	Describe threshold effect in a DSB-AM system.	3	6
10	"It is possible to trade-off bandwidth for SNR in angle modulation system"- justify this statement with suitable expression/ logic.	3	6
11	In a box of 100 bulbs 30 bulbs are defective. What is probability of getting more than 2 defective bulbs if 5 are chosen randomly from the box? (a) 0.161 (b) 0.162 (c) 0.163 (d) 0.164	1	5
12	If X is a random variable with the expected value of 5 and the variance of 1 then the mean of the square of X is: (a) 24 (b) 25 (c) 26 (d) 36	1	5
13	Drawbacks of using direct method for generation of FM signal are a. Does not give high stability to FM signal frequency b. Distorted FM signal is generated due to harmonics of modulating signal c. Cannot be used for high power FM generation d. Both a and b	1	4

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: ECC402
Course Name: Digital Circuits and Systems
Question Paper No.: NITDGP/ECC402/1

Full Marks: 30
Time: 90 Minutes
Date of Exam: 26/04/2022

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO
1	Design and implement a full adder circuit using two half adders and OR gate.	5	CO3
2	Design a BCD synchronous counter using T Flip-Flops and draw the counter circuit diagram and illustrate the state table.	5	CO3, CO5
3	Implement the following function using a multiplexer $F(x,y,z)=\Sigma(1,2,6,7)$	5	CO2
4	Explain and derive characteristics equation and characteristic table for edge triggered J-K, D, and T Flip-Flops.	5	CO2
5	Design a 4 X 16 decoder constructed with two 3 X 8 decoders and one enable input.	5	CO2
6	(a) Implement the following function using NAND-AND and AND-NOR logic gates- $F = \overline{(AB + CD + E)}$ (b) Explain Mealy and Moor finite state machine with any state graph example.	5	CO1, CO5

Course Outcomes
CO1: Understand rules of Boolean Algebra and use it for logic synthesis
CO2: Design sequential logic circuits using switches, transistors and integrated circuit building blocks.
CO3: Understand binary number system and design corresponding arithmetic circuits.
CO5: Learn sequential circuit building blocks and implement Finite State Machines

2021 - 2022

~~B. Tech~~/B. E. ~~odd~~/even Semester Examinations Jan-June 2022

Subject : Electromagnetic theory and transmission lines.

Code : ECE-403 , End-term Examination. B.Tech, Branch-EC, Sem-4th

Time 1 hr. 30 minutes Full marks 30

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

half

Answer Any three questions

Instructions

Question No.	Questions	Marks
1.	Find out surface resistance and surface reactance of good conductors after deriving the surface impedance.	10
2.	Find out α, β, V, v and η for the uniform plane wave propagation in (i) good dielectric (ii) good conductor.	10
3.	An open wire or parallel wire transmission line has the following distributed circuit parameters : $R = 4.5\ \Omega/km$, $L = 1.2 \times 10^{-3}$ Henry/km, $G = 5 \times 10^{-6}$ $\mho$/km and $C = 0.06 \times 10^{-6}$ F/km. Find the values of V, α, β, Z_0 and v. The frequency used was 796 Hz.	10
4.	A low-loss high frequency resonant quarter-wave copper co-axial transmission line 25 cm long has $b = 1$ cm and $b/a = 3.6$. Determine the resonant frequency, Q and bandwidth.	10

NITDGP/BTECH/Reg/Even/2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: ECC601 Full Marks: 30

Course Name: Antenna and Wave Propagation Time: 90 Minutes

Question Paper No.: NITDGP/ECC601/ Date of Exam: 18/04/2022

Instructions: Answer all the questions.

Section A: Select the correct options from the following questions

Question No.	Body of the Question	Marks	Mapped CO
1.	If the diameter of a dish antenna is doubled, the change in gain will be explained by --------- of its previous value (a) half (b) double (c) four times (d) remained same as	1	CO1
2.	An antenna is explained as follows. The directivity of the antenna with maximum aperture dimension of $\lambda/\sqrt{2}$ is 100. Its efficiency is 90% and frequency of operation is 300 MHz. The maximum effective aperture is (a) 6.28 (b) 5.65 (c) 7.164 (d) 7.96	1	CO1
3.	The following statements are made to understand a center fed dipole antenna. (I) $\lambda/2$ dipole provides highest input impedance for radiation. (II) The preferable length of a center fed dipole antenna is made slightly greater than $\lambda/2$ to cancel out the effect of reactive part of its input impedance. (III) The preferable length of a center fed dipole antenna is made slightly less than $\lambda/2$ to cancel out the effect of reactive part of its input impedance. (IV) With dipole length of about $\lambda/2$, the input impedance becomes equal to that of the radiation resistance for efficient radiation. The correct statements are (a) I, II & IV (b) II & IV (c) III & IV (d) I & IV	1	CO2
4.	In antenna system, '*balun*' is designed (I) to make the system *balance to unbalance*. (II) to make the system *unbalance to balance*. (III) to balance inherently unbalanced systems, by canceling or choking the outside current. (IV) to unbalance inherently balanced systems, by equalizing the outside current. The correct statements are (a) I & IV (b) II & IV (c) I & III (d) II & III	1	CO5
5.	The log periodic antenna is classified based on which of the following characteristics. (I) If the input impedance of a log-periodic antenna is plotted as a function of frequency, it will be repetitive. (II) If the input impedance of a log-periodic antenna is plotted as a function of the logarithm of the frequency, it will be periodic with each cycle being exactly identical to the preceding one (III) If the radiated power is plotted as function of the azimuthal or elevation angle, the pattern will be periodic in nature	1	CO3

Course Outcomes

CO # 1. **Explain** the concepts of antenna radiation patterns and various parameters for characterizing the antenna.

CO # 2. **Understand** different modes of radio wave propagation.

CO # 3. **Classify** various antennas on the basis of their electrical performances.

CO # 4. **Analyze** various antennas and antenna arrays.

CO # 5. **Design** antenna and antenna arrays for different applications.

	(IV) If the radiated field is plotted as function of the azimuthal or elevation angle, the pattern will be periodic in nature. The correct statements are (a) I, II & III (b) I, III & IV (c) II, III & IV (d) I & II Only		
6.	The analysis of the fringing effect in microstrip patch antenna states that (I) It increases the actual length (L) and width (W) of the patch (II) It depends on the ratio of the length of the patch (L) to the height (h) of the substrate (L/h). (III) It depends on the ratio of the width of the patch (W) to the height (h) of the substrate (W/h). (IV) It depends on the dielectric constant ε_r of the substrate. Which of the above statements are correct (a) II & IV (b) II, III & IV (c) I, III & IV (d) All of these	1	CO4
Section B: Answer any six from the following questions			
1.	Explain the function of individual element of a three element Yagi-Uda antenna.	4	CO1
2.	Understand the electric field given by $\underline{E} = \left(2\hat{a}_x + j2\hat{a}_y\right)e^{jkz}$ and determine the type of polarization and sense of rotation if any.	4	CO2
3.	Derive an expression for the input impedance of a two-armed folded λ/2 dipole in terms of the input impedance of a center fed λ/2 dipole.	4	CO3
4.	An antenna with a gain of 12 dB and an effective aperture of 3 m^2 is used to receive electromagnetic energy propagating in free space. If the received power into a matched load is 0.1 nW, what is the power density of the wave at the antenna?	4	CO4
5.	A pyramidal horn antenna with aperture dimensions of 9 × 8 cm and efficiency of 0:6 is designed for operating at frequency 5 GHz. Calculate the directivity, gain in dB and beamwidth in E and H -planes.	4	CO5
6.	For a log-periodic dipole array with 4 to 1 bandwidth, apex angle $\alpha = 15^0$ and spacing factor $s_\lambda = 0.15$, determine the design scale constant k and number of elements.	4	CO5

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: ECC 602
Course Name: VLSI Design
Question Paper No.: NITDGP/ECC602/1

Full Marks: 30
Time: 90 Minutes
Date of Exam: 19/04/2022

Instructions: i) Answer all the questions.
ii) Assume missing data, if any, suitably.
iii) Optimized circuit design will be preferred over un-optimized design.

Question No.	Body of the Question	Marks	Mapped CO
1	The two critical voltage points, dV_{out} / DV_{in} = -1, are considered to determine the noise margin in case of static characteristics of an inverter. Give physical justification of these points	5	CO4
2	Compare all the inverters and, write a summary in terms of power, area, noise, and performance.	5	CO1 & CO2
3	Consider a CMOS inverter circuit with the following parameters: ▪ V_{DD} = 2.3 V ▪ $V_{T0,n}$ = 0.5 V ▪ $V_{T0,p}$ = -0.6 V ▪ k_n = 150 μA/V^2 ▪ k_P = 70 μA/V^2 Calculate the noise margins of the circuit. Notice that the CMOS inverter being considered here has k_R =2 and $V_{T0,n} \neq \lvert V_{T0,p} \rvert$; hence, it is not a symmetric inverter.	5	CO2
4	Estimate the delay of a fanout-of-4 inverter using RC delay model as well as logical effort and compare.	2 + 2 +1 =5	CO5
5	A 128-bit off-chip bus operating at 2.5V and 1GHz clock rate is driving a capacitance of 3.5pF/bit. Each bit is estimated to have toggling probability of 0.25 at each clock cycle. What is the power dissipation in operating the bus?	5	CO6
6	Setup timing analysis: T_{clk} = 1ns, T_{combo} = 650ps, T_{cq} =120ps, T_{cbuff} =20ps, T_{su} =180ps. Is there any setup time violation? If yes, how can we avoid it? Explain.	5	CO4

Course Outcomes
CO1: Acquire idea about the digital IC design techniques.
CO2: Understand the characteristics of CMOS inverter.
CO3: Identify the basic steps of ASIC Design Flow and fabrication process.
CO4: Analyze the static and dynamic characteristics of CMOS circuits
CO5: Design and implementation of combinational and sequential circuits
CO6: Evaluate the performance of CMOS circuits

ECC 603, Digital Signal Processing, End Semester Exam, 2021-22, Regular

Total Marks: 30, Time duration: 1:30hrs

Answer all the questions.

Section: A

(6x1=6)

1. How many complex multiplications are needed to be performed for each FFT algorithm?

   a) (N/2)logN

   b) $N\log_2 N$

   c) $(N/2)\log_2 N$

   d) None of the mentioned

2. What is the value of magnitude frequency response of a Butterworth low pass filter at $\Omega=0$?

   a) 0.1

   b) 1

   c) $1/\sqrt{2}$

   d) None of the mentioned

3. What is the magnitude squared response of the normalized low pass Butterworth filter?

   a) $1/(1+\Omega^{-2N})$

   b) $1+\Omega^{-2N}$

   c) $1+\Omega^{2N}$

   d) $1/(1+\Omega^{2N})$

4. What is the Butterworth polynomial of order 3?

   a) $(s^2+s+1)(s-1)$

   b) $(s^2-s+1)(s-1)$

   c) $(s^2-s+1)(s+1)$

   d) $(s^2+s+1)(s+1)$

11.04.2022

5. What is the value of the Chebyshev polynomial of degree 0?
   a) 1
   b) 0
   c) -1
   d) 2
6. Which of the following filters cannot be designed using the impulse invariance method?
   a) Low pass
   b) Bandpass
   c) Low and bandpass
   d) High pass

Section B

(Answer any four questions)

(6x4=24)

7. Design an Analog Butterworth filter with a -2dB passband attenuation at a frequency of 20rad/s and at least -10dB stopband attenuation at 30rad/s.
8. Given the specification of α_p=3dB, α_s=16 dB, f_p=1kHz, f_s=2kHz. Determine the order of the filter using Chebyshev approximation. Also, find H(s).
9. Determine the 8 point DFT of sequence x(n) = {1, 1, 1, 1, 0, 0, 0, 0}, using DIT-FFT algorithm.
10. Design a third-order Butterworth digital filter using the impulse invariant method, T=1s.
11. Compare FIR and IIR filters.

11.04.22