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Total number of pages: 1

Roll no.:..................

Third Semester-B.Tech Course work
Mid Semester Examination, September, 2022

Course code: ECMTC04
Course title: Mathematics for Signal Processing and Communication

Time: 1 hour 30 minutes

Maximum Marks. 25

Note: All questions are compulsory. Missing data/information (if any), may be suitably assumed and mentioned in the answer.

Q. No.	Question	Marks	CO
1a	If every element of a group is its own inverse, then show that the group must be abelian.	2.5	CO1
1b	Show that if a, b are any two elements of a group G, then $(ab)^2 = a^2b^2$ if and only if G is abelian.	2.5	CO1
2a	Define cyclic group. How many generators are there of the cyclic group G of order 8?.	2.5	CO1
2b	Define homomorphism on a group. Prove or disprove that $U(12)$ is cyclic group.	2.5	CO1
3a	Show that the Gaussian integer $J(i) = \{a + ib : a, b \in Z\}$ is commutative ring. Is it an integral domain?. Is it a field?.	2.5	CO1
3b	Let $V = \mathbf{R}^3(\mathbf{R})$ be a vector space, then show that $W = \{(a, b, c) \in \mathbf{R} : a + b + c = 0\}$ is a subspace of $\mathbf{R}^3(\mathbf{R})$.	2.5	CO2
4a	If v_1, v_2, v_3 are linearly independent vectors of $V(F)$, then show that $v_1 + v_2$, $v_2 + v_3$, $v_3 + v_1$ are also linearly independent.	2.5	CO2
4b	Define Basis of a vector space. Show that the vectors $\{(1, 2, 1), (2, 1, 0), (1, -1, 2)\}$ form a basis of $\mathbf{R}^3(\mathbf{R})$.	2.5	CO2
5a	Show that $T : \mathbf{R}^2 \to \mathbf{R}^2$ defined by $T(x, y) = (x + y, x)$ is linear transformation.	2.5	CO2
5b	Let $T : \mathbf{R}^3 \to \mathbf{R}^3$ be the linear transformation defined by $T(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$. Find the dimension of null space of T.	2.5	CO2

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Date: Roll No.

III SEMESTER B.Tech (ECE, EIOT)

MID-SEMESTER EXAMINATION 2022

Course Code- ECECC05 / EIECC05 Course Title- Signals & Systems

Time: 1:30 Hrs Max Marks: 25

Attempt all questions. Missing data / information (If any) may be suitably assumed & mentioned in the answer.

Q. No.		Questions	Marks	CO
Q 1	a	Express the following functions in terms of shifted/flipped versions of the unit step function [i.e $u(\pm t - t_0)$], i. $u(2t+6)$ ii. $u\left(-\frac{t}{4}+2\right)$ iii. In each case sketch the function.	04	CO1
	b	Consider the following continuous-time signal: $$x(t) = 2\sin\left(\frac{2\pi(t-T)}{10}\right)$$ Determine the values of T for which the signal is (i) An **even function** (ii) An **odd function**	01	CO1
Q 2	a	Determine whether the system described by $y(t) = \int_t^{t+1} x(\tau - a)d\tau$, is an LTI system? Here 'α' is a constant. For what values of 'α' is the system causal, stable.	04	CO1
	b	What do you understand by BIBO Stability of Systems? Explain with the help of examples.	01	CO1

Q 3	a	A Linear Time Invariant system with an impulse response h(t) produces output y(t) when input x(t) is applied. When the integral of x(t) is applied to a system with impulse response h(t – T), find the output in terms of y(t). Here T is a constant.	04	CO2
	b	Let y[n] denote the convolution of h[n] and g[n], where h[n] = $(1/2)^n$ u[n] and g[n]=0 for n<0 (causal sequence). If y[0] = 1 and y[1] = ½, then find g[1].	01	CO2
Q 4	a	Compute and plot the convolution of x[n] and h[n]. Where, the input $x_1[n] = \left(\frac{1}{3}\right)^{-n} u[-n-1]$ and impulse response $h[n] = u[n-1]$. Compute the system output when the input is $x_2[n] = \left(\frac{1}{3}\right)^{n} u[n-1]$.	04	CO2
	b	Is x[n]=$\cos\left(\frac{n}{2}\right)\cos\left(\frac{\pi n}{4}\right)$ periodic? If yes what is it's time period.	01	CO1
Q 5	a	The input x[n] and output y[n] of a system are related as y[n]=x[n].u[n-2]. Is the system Linear, Stable, Causal and Time Invariant?	04	CO1
	b	Determine if x[n] = n u[n+2] – nu[n-1] is an energy or Power Signal. Determine the Energy/Power of 4x[n-6].	01	CO1

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Date　　　　　　　　　　　　　　　　　　　　Roll No.

THIRD SEMESTER-B.TECH.(ECE & EIOT)

MID-SEMESTER EXAMINATION, September 2022

Course Code- ECECC06/EIECC06　　　Course Title- Probability Theory and Stochastic Process

Time 1:30 Hrs　　　　　　　　　　　　　　　　Max Marks: 25

Attempt all questions. Missing data / information (If any) may be suitably assumed & mentioned in the answer

Q. No.	Questions	Marks	CO
Q 1	(a) A continuous random variable X has the PDF $f_X(x) = \begin{cases} \frac{1}{3}e^{-x/3}, & x > 0 \\ 0, & otherwise \end{cases}$ Find moment generating function of X.	3	CO3
	b) Let X is a random variable and its PDF is given by: $f_X(x) = \begin{cases} \frac{1}{3} & 0 < x < 1 \\ \frac{2x^2}{7} & 1 \le x \le 2 \\ 0 & otherwise \end{cases}$ Calculate (i) CDF (ii) E[X]	2	CO1
Q 2	a) A random variable X is Gaussian distributed with $mean = 0$ and $\sigma_x = 1$. Find $P[\|X\| > 2]$. Given erf(1.41)=0.9533, and erf(1.35)=0.94376	3	CO2
	b) The lifetime of a system expressed in weeks is a Rayleigh random variable X defined as $f_X(x) = \begin{cases} (x/200)e^{-x^2/400} & 0 \le x \\ 0 & x < 0 \end{cases}$ What is the probability that the system lifetime will exceed one year?	2	CO1
Q 3	a) Suppose the depth of water, measured in meters, behind the dam is defined by random variable having density function $f_X(x) = (1/13.5)u(x)e^{-(x/13.5)}$ There is an emergency overflow at the top of the dam that prevents the depth from exceeding 40.6 m. There is a pipe placed 32.0m below the overflow that feeds water to the hydroelectric generator. What is the probability that the water is wasted through emergency overflow?	3	CO2
	b) Consider the function given $F(x) = \begin{cases} 0 \ldots\ldots\ldots x < 0 \\ x + \frac{1}{2} \ldots\ldots 0 \le x < 1/2 \\ 1 \ldots\ldots\ldots x \ge 1/2 \end{cases}$ Find (i) P (X ≤ 1/4) (ii) P (0 < X ≤ 1/4)		
Q 4	a) Let X be a random variable with cdf $F_X(x) = \begin{cases} 1, x \ge 1 \\ \frac{1}{2} + \frac{x}{2}, 0 \le x < 1 \\ 0, x < 0 \end{cases}$ Find P(X=0|X≤ 0.5)	2	CO2
	b) The number of telephone calls arriving at a switchboard during any 10 min period is known to be Poisson random variable X with parameter λ =2. Find the probability (i) that more than three calls will arrive during any 10 minute period (ii) that no calls will arrive during any 10 minute period	3	CO1
Q 5	a) Let X and Y be Joint continuous random variables with joint PDF is given below $f_{XY}(x,y) = \begin{cases} Cx + 1 & x, y \ge 0 \text{ and } x + y < 1 \\ 0 & otherwise \end{cases}$ (i) Find the constant C (ii) Find the marginal PDFs $f_X(x)$ and $f_Y(y)$	3.0	CO2
	b) A company producing electric relays has three manufacturing plants producing 50, 30 and 20 percent, respectively, of its product. Suppose that the probabilities that a relay manufactured by these plants is defective are 0.02, 0.05 and 0.01 respectively. i. If a relay is selected at random from the output of the company, what is the probability that it is defective? ii. If a relay selected at random is found to be defective, what is the probability that it was manufactured by plant 2?	2.0	CO1

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B.Tech. (ECE)

MID SEM. EXAMINATION, sept 2022

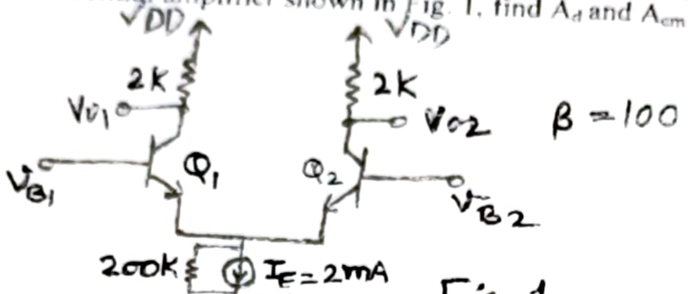
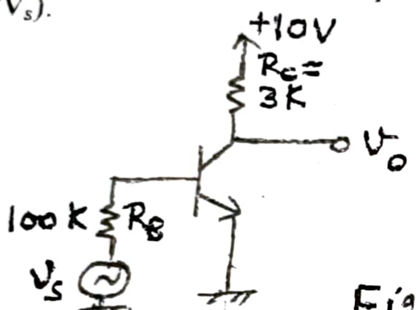
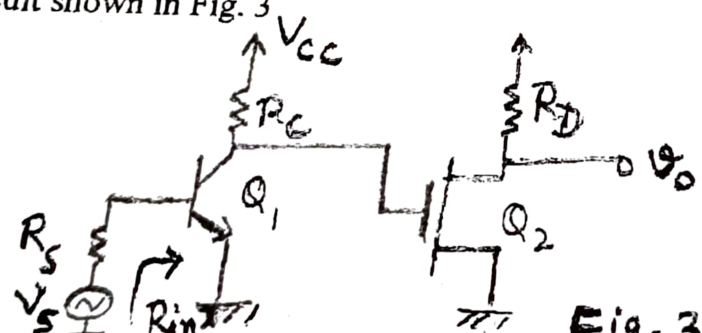
Course Code: ECECC07

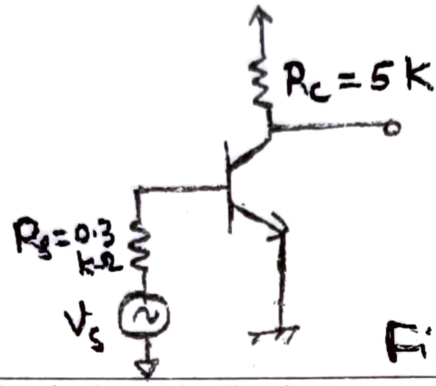
Course Title: Microelectronics

Time: 01:30 Hrs.

Max. Marks: 15

Note: Attempt all the five questions. All questions carry equal marks. Missing data/information if any should be suitably assumed and mentioned in the answer.

Q. No.	Question	Marks	CO
Q1(a)	For the differential amplifier shown in Fig. 1, find A_d and A_{cm}  Fig. 1	(2)	CO2
1(b)	Define CMRR for differential amplifier and calculate the same for the circuit shown in Fig. 1.	(1)	CO2
2(a)	In CE amplifier shown in Fig.2, the parameters are β =100, I_{CQ}=2.3 mA, r_o=∞. Find A_v=(V_o/V_s).  Fig. 2	(2)	CO1
2(b)	i) Find Rin for the circuit shown in Fig. 2. *ii) Explain how voltage gain will be affected when a resistance is added in emitter of Fig. 2.*	(1)	CO1
(a)	For the circuit shown in Fig. 3  Fig. 3 i) Draw small signal equivalent circuit. *ii) Find overall gain*	(2)	CO2
	Find input impedance (Rin) of the circuit given in Fig. 3.	(1)	CO2
	Draw the circuit diagram of Darlington pair using BJT and also draw its small signal equivalent circuit.	(2)	CO2

4(b)	Find input impedance of Darlington pair.	(1)	CO2
5(a)	For the circuit shown in Fig. 4, $\beta = 100$, $V_A = 100$ V, $I_{CQ} = 1$ mA, $C_\pi = 19.5$ pF and $C_\mu = 0.5$ pF. Draw small signal high frequency equivalent circuit.  Fig. 4	(4)	CO3
5(b)	Find f_H of the circuit shown in Fig. 4.	(3)	CO3

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Netaji Subhas University of Technology

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MID Semester of IIIrd Semester B.Tech- ECEIoT

MID-SEMESTER EXAMINATION, SEPTEMBER, 2022

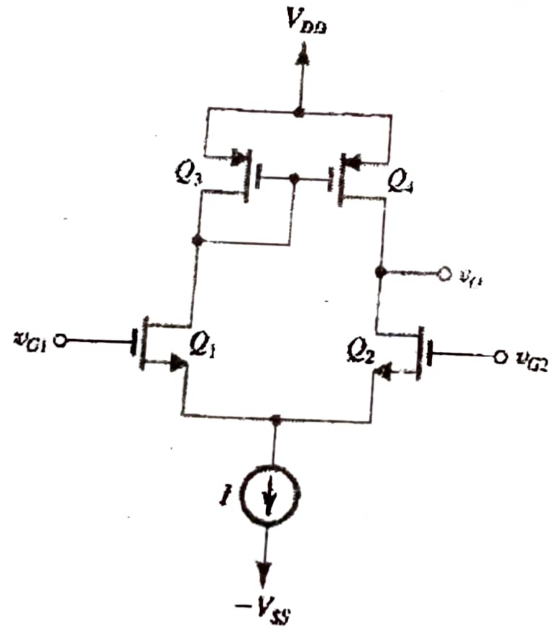
Course Code- EIECC07

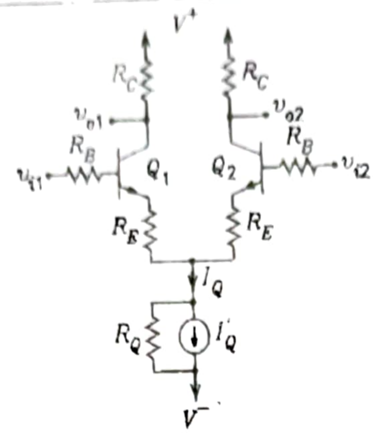
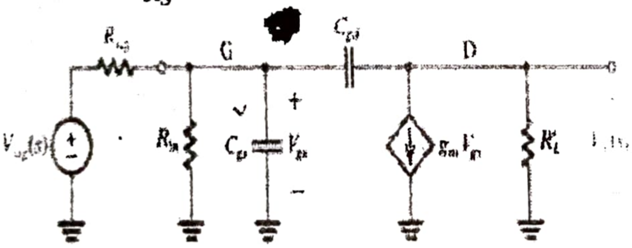
Course Title- Microelectronics Circuits and Applications

Time- 1.5 Hour

Max.Marks- 15

Note:- Attempt all questions. Missing data/information (if any), may be suitably assumed &mentioned in the answer.

Q. No	Question	Marks	CO
1a	To design active-loaded differential amplifier as shown in fig.1 to obtain differential gain of 50V/V. The technology available provides $\mu nCox= 4\mu pCox=400\mu A/V^2$, $\lvert VA\rvert=10$, $L=0.5\mu m$, $\lvert Vt\rvert=0.5V$, and operates from ±1V supplies. Use a bias current $I=200\mu A$ and operate all devices at $\lvert VGS-Vt\rvert=0.2V$. (a) Find the W/L ratios of the four transistors.  Fig.1	1.5	CO2
	For the Fig.1 of question (1), If I is delivered by a simple NMOS current source operated at the same VGS-Vt and having the same channel length as the other four transistors, determine the CMRR obtained.	1.5	CO1

2a	 Fig.2 For I_Q = 2Am, R_Q = 50 kΩ, R_B = 1kΩ, R_E = 100 Ω, R_C = 10 kΩ, V^+ = 20 V, V − = −20 V, V_T = 0.025 V, r_x = 20 Ω, β = 99, V_{BE} = 0.65 V, and V_A = 50 V, calculate v_{o1}, v_{o2}.	1.5	CO2
2b	Find r_{out} and CMRR for the Fig.2 shown in Question.2a	1.5	CO2
3a	Explain any three biasing techniques in Amplifiers.	1.5	CO1
3b	For the high frequency equivalent circuit of a common source MOSFET amplifier shown in Fig.3 having R_{sig}= 100KΩ, R_{in}= 4.7MΩ, Cgs=1 pF, Cgd =0.4pF, gm= 1mA/V and R_L= R_D= 15KΩ, Find the midband gain $A_M = \frac{V_o}{V_{sig}}$ and upper 3-dB frequency  Fig.3	1.5	CO1
4a	What is the Miller's theorem, explain in detail.	1.5	CO1
4b	Consider CG amplifier circuit which has gm= 1mA/V, R_{sig}= 50Ω, R_D= 15KΩ, R_L= 15KΩ. Find Rin, R_{OUT}, Av,Avo, and Gv .	1.5	CO1
5a	For CS stage with resistive load amplifier prove that Gain = −gmrd	1.5	CO1
5b	Explain the operation of a MOS differential pair with common mode input voltage.	1.5	CO2

THIRD SEMESTER-B.TECH.(ECE & EIOT)

MID-SEMESTER EXAMINATION, September 2022

Course Code- ECECC06/EIECC06 Course Title- Probability Theory and Stochastic Process

Time: 1:30 Hrs Max Marks: 25

Attempt all questions. Missing data / information (If any) may be suitably assumed & mentioned in the answer.

Q. No.	Questions	Marks	CO
Q 1	(a) A continuous random variable X has the PDF $f_X(x) = \begin{cases} \frac{1}{3}e^{-x/3}, & x > 0 \\ 0, & otherwise \end{cases}$ Find moment generating function of X.	3	CO3
	b) Let X is a random variable and its PDF is given by: $f_X(x) = \begin{cases} \frac{1}{3} & 0 < x < 1 \\ \frac{2x^2}{7} & 1 \le x \le 2 \\ 0 & otherwise \end{cases}$ Calculate: (i) CDF (ii) E[X]	2	CO1
Q 2	a) A random variable X is Gaussian distributed with $mean = 0$ and $\sigma_X = 1$. Find $P[\lvert X\rvert > 2]$. Given erf(1.41)=0.9533, and erf(1.35)=0,94376	3	CO2
	b) The lifetime of a system expressed in weeks is a Rayleigh random variable X defined as $f_X(x) = \begin{cases} (x/200)e^{-x^2/400} & 0 \le x \\ 0 & x < 0 \end{cases}$ What is the probability that the system lifetime will exceed one year?	2	CO1
Q 3	a) Suppose the depth of water, measured in meters, behind the dam is defined by random variable having density function $f_X(x) = (1/13.5)u(x)e^{-(x/13.5)}$ There is an emergency overflow at the top of the dam that prevents the depth from exceeding 40.6 m. There is a pipe placed 32.0m below the overflow that feeds water to the hydroelectric generator. What is the probability that the water is wasted through emergency overflow?	3	CO2
	b) Consider the function given	2	CO2

	$$F(x) = \begin{cases} 0 & x < 0 \\ x + \frac{1}{2} & 0 \le x < 1/2 \\ 1 & x \ge 1/2 \end{cases}$$ Find (i) P $(X \le 1/4)$ (ii) P $(0 < X \le 1/4)$		
Q 4	a) Let X be a random variable with cdf $$F_X(x) = \begin{cases} 1, x \ge 1 \\ \frac{1}{2} + \frac{x}{2}, 0 \le x < 1 \\ 0, x < 0 \end{cases}$$ Find $P(X=0 \mid X \le 0.5)$	2	CO2
	b) The number of telephone calls arriving at a switchboard during any 10 min period is known to be Poisson random variable X with parameter λ =2. Find the probability (i) that more than three calls will arrive during any 10 minute period (ii) that no calls will arrive during any 10 minute period	3	CO1
Q 5	a) Let X and Y be Joint continuous random variables with joint PDF is given below $$f_{XY}(x,y) = \begin{cases} Cx + 1 & x, y \ge 0 \text{ and } x + y < 1 \\ 0 & otherwise \end{cases}$$ (i) Find the constant C (ii) Find the marginal PDFs $f_X(x)$ and $f_Y(y)$	3.0	CO2
	b) A company producing electric relays has three manufacturing plants producing 50, 30 and 20 percent, respectively, of its product. Suppose that the probabilities that a relay manufactured by these plants is defective are 0.02, 0.05 and 0.01 respectively. i. If a relay is selected at random from the output of the company, what is the probability that it is defective? ii. If a relay selected at random is found to be defective, what is the probability that it was manufactured by plant 2?	2.0	CO1

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Date: Roll No.

III SEMESTER B.Tech (IT, ITNS)

MID-SEMESTER EXAMINATION 2022

Course Code-INECC06/ITECC06 Course Title-Probability & Stochastic Processes

Time: 1:30 Hrs Max Marks: 25

Attempt all questions. Missing data / information (If any) may be suitably assumed & mentioned in the answer.

Q. No.	Questions	Marks	CO
1	a) Events A, B and C are independent, with $P(A) = a$, $P(B) = b$ and $P(C) = c$. Determine the following probabilities in terms of a, b and c. i. $P(AB)$ ii. $P(A \cup B)$ iii. $P(A \cup B \mid B)$ iv. $P(A \cup B \mid C)$	04	CO1
	b) In the coin tossing experiment, the probability of heads (H) equals 'p' and the probability of tails (T) equals 'q'. We define a random variable X such that $X(H) = 1$ and $X(T) = 0$. Plot the CDF $F(x)$ for every x from $-\infty$ to ∞.	01	CO2
2	a) Events A and B are mutually exclusive. Determine which of the following are true and which are false. Explain the reasons. i. $P(A/B) = P(A)$ ii. $P(A \cup B \mid C) = P(A/C) + P(B/C)$ iii. $P(A) = 0$, or $P(B) = 0$, or both. iv. $\frac{P(A\mid B)}{P(B)} = \frac{P(B\mid A)}{p(A)}$ v. $P(AB) = P(A)P(B)$	04	CO1
	b) State the axioms of Probability.	01	CO1

Q.	Question	Marks	CO
3	a) A random variable X has CDF given as $$F_X(x) = \begin{cases} 0 & \text{for } x < 0 \\ 1 - \frac{1}{4}e^{-2x} & \text{for } x \geq 0 \end{cases}$$ i. Plot the CDF and identify the type of random variable ii. Find $P[X \leq 2]$, $P[X = 0]$, $P[X < 0]$, $P[2 < X < 6]$, $P[X > 10]$	04	CO2
	b) State the Poisson distribution for random variable X with parameter λ if X takes on values $0, 1, 2, \ldots \ldots \infty$. Find p_{k-1}/p_k in terms of k and λ.	01	CO2
4	a) Let X be the exponential random variable. i. Find and plot $F_X(x\|X > t)$. How does $F_X(x\|X > t)$ differ from $F_X(x)$? ii. Find and plot $f_X(x\|X > t)$. iii. Show that $P\{X > t + x\|X > t\} = P[X > x]$. Explain why this is called the memoryless property.	04	CO2
	b) Express $P[\|Y\| < y]$ in terms of the CDF of Y.	01	CO2
5	a) A target is made of three concentric circles of radii $3^{-\frac{1}{2}}, 1,$ and $3^{1/2}$ feet. Shots within the inner circle count 4 points, within the next ring 3 points, and within the third ring 2 points. Shots outside of the target count 0. Let R be the random variable representing distance of the hit from the centre. Suppose that the PDF of R is $$f_R(r) = \begin{cases} \frac{2}{\pi(1 + r^2)} & \text{for } r > 0 \\ 0 & \text{elsewhere} \end{cases}$$ Compute the mean score.	04	CO2
	b) Let the mean and variance of X be m and σ^2 respectively. For what values of a and b does the random variable $Y = aX + b$ have mean ZERO and variance ONE?	01	CO2

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B.Tech. III Semester (ECE/EIoT)

Roll no. 53

MID-SEMESTER EXAMINATION, SEPTEMBER 2022

Course Code: ECECC08/EIECC08

Course Title: DIGITAL CIRCUITS AND SYSTEMS

Time: 1:30 Hours

Max. Marks: 15

Note: Attempt all questions. Missing data/information (if any), may be suitably assumed and mentioned in the answer.

Q.No.	Question	Marks	CO
1	Simplify the following Boolean function F with the don't-care conditions d and express in the SOP form $F(A, B, C, D) = \Sigma (5, 6, 7, 12, 14, 15)$ and $d(A, B, C, D) = \Sigma (3,9,11)$ (a) Express in the SOP form (b) Express in the POS form	1.5+ 1.5	CO1
2	(a) Implement the expression obtained in Q1 using NOR gates only. (b) If X=1 in the logic equation $[X+Z\{Y'+(Z'+XY')\}]\{X'+Z'(X+Y)\}=1$, then determine the value of Z.	1.5+ 1.5	CO3 CO1
3	Reduce the following Boolean expressions using boolean laws (a) $F(w,x,y,z)= \overline{(xy + z)} + z + xy + wz$ (b) $F(A,B,C,D) = AB(D + CD) + B(A + ACD)$	1.5+ 1.5	CO1
4	Perform subtraction on the given numbers (a) 100010.001 - 111.11 using the 2's complement (b) 163.25 - 745 using the 9's complement	1.5+ 1.5	CO1
5	(a) Draw a basic CMOS inverter circuit. (b) Find the Maxterms of the following expression $F(w,x,y,z) = (w+x')(w'+y+z')(x+y'+z')$	1.5+ 1.5	CO2 CO1

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23/9/22 (I) FN)

Total no. of pages 1 Roll no.________

B.Tech. III Semester (EE/ICE)

MID-SEMESTER EXAMINATION, SEPTEMBER 2022

Course Code: ICECC08/ EEECC08
Course Title: DIGITAL CIRCUITS AND SYSTEMS

Time: 1:30 Hours Max. Marks: 25

Note: Attempt all questions. Missing data/information (if any), may be suitably assumed and mentioned in the answer.

Q.No.	Question	Marks	CO
1	Simplify the following Boolean function F with the don't-care conditions d and express in the SOP form $F(A, B, C, D) = \Sigma\,(5, 6, 7, 12, 14, 15)$ and $d(A, B, C, D) = \Sigma\,(3,9,11)$ (a) Express in the SOP form (b) Express in the POS form	2.5+ 2.5	CO1
2	(a) Implement the expression obtained in Q1 using NOR gates only. (b) If X=1 in the logic equation $[X+Z\{Y'+(Z'+XY')\}]\{X'+Z'(X+Y)\}=1$, then determine the value of Z.	2.5+ 2.5	CO3 CO1
3	Reduce the following Boolean expressions using boolean laws (a) $F(w,x,y,z)=\overline{(xy + z)} + z + xy + wz$ (b) $F(A,B,C,D) = AB(D + CD) + B(A + ACD)$	2.5+ 2.5	CO1
4	Perform subtraction on the given numbers (a) 100010.001 - 111.11 using the 2's complement (b) 163.25 - 745 using the 9's complement	2.5+ 2.5	CO1
5	(a) Draw a basic CMOS inverter circuit. (b) Find the Maxterms of the following expression $F(w,x,y,z) = (w+x')(w'+y+z')(x+y'+z')$	2.5+ 2.5	CO2 CO1