2023 – 24
B.TECH. (AUTUMN SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
COMMUNICATION NETWORKS
ELC4410

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all the questions.
Any missing information can suitably be assumed.
Notations used have their usual meaning.

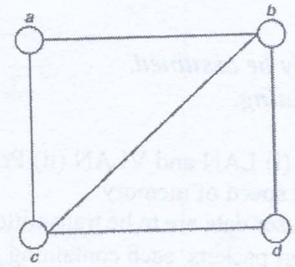
1(a)	(CO1) Differentiate between (i) LAN and VLAN (ii) Propagation Delay and Transmit Time (iii) Speed of a link and speed of memory	7
(b)	(CO1) Suppose that x bits of user data are to be transmitted over a k hop path in a packet switched network as a series of packets, each containing p data bits and h header bits. with $x >> p + h$. The bit rate of the lines is b bps and the propagation delay is negligible. What value of p minimizes the total delay?	7
	OR	
(b′)	(CO1) A stop-and-wait protocol uses acks and time-outs only. The ack arrives at the transmitter at time t_s after the frame transmission. Take $t_{out} > t_s$. Frames are all of length t_f and are always available for transmission. A frame is received in error for probability p. Find the maximum frame throughput.	7
2 (a)	(CO2) With the help of an example show that tree algorithm can resolve a collision. What can be the limitations of a tree algorithm?	6
(b)	(CO2) The average time T a car spends in a certain traffic system is related to the average number of cars N in the system by a relation of the form $T = \alpha + \beta N^2$, where $\alpha > 0, \beta > 0$ are given scalars. What is the maximum car arrival rate λ^* that the system can sustain?	6
3(a)	(CO3) List the demerits of Virtual circuit packet switching and give reasons that these can be overcome by using datagram switching.	6

Contd.....2.

(b) (CO3) Consider the simple network shown in Figure. All links are bidirectional and have a capacity of 1 unit in each direction.

(a) How many source–destination pairs are there in this network?

(b) Give an upper bound to the maximum traffic that this network can carry



8

OR

(b′) (CO3) Consider a packet-switching network for server communications with n nodes. For each of the following topologies, sketch the network, and give the average number of hops between a pair of servers (include the server-to-node link as a hop)

(a) Star: one central node with all servers attached to the central node.

(b) Bidirectional ring: each node connects to two other nodes to form a loop, with each node connected to one server. 8

4(a) (CO4) Discuss the term 'multi-homing'. Can you do it with IPv6 type of networks? 6

(b) (CO4) What is VPN? Discuss a few merits of having a VPN. 6

(c) (CO4) An organization is granted the block 211.17.180.0/24. The administrator wants to create 32 subnets.

i. Find the subnet mask.

ii. Find the number of addresses in each subnet.

iii. Find the first and the last address in the first subnet.

iv. Find the first and the last address in the last subnet (subnet 32). 8

OR

4′(a) (CO4) How does an email originated from the office of a network user reach to the destination? 6

(b) (CO4) What is SCTP protocol? How does it work? 6

(c) (CO4) In a connection, the value of cwnd is 3000 and the value of rwnd is 5000. The host has sent 2000 bytes which has not been acknowledged. How many more bytes can be sent? 8

2023-2024
B. TECH. (ODD SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
SEMICONDUCTOR DEVICE MODELLING
ELE-4120

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Values of some constants: Energy gap for Si = 1.12 eV; Thermal voltage (kT/e = 25 mV at room Temp.); Permittivity of free space (ε_o = 8.85x10^{-12} F/m); Permittivity of silicon (ε_{si} = 12 ε_o); Permittivity of oxide (ε_{ox} = 3.9 ε_o); $n_i = 10^{10} cm^{-3}$, $N_C = 2.8\times10^{19}\ cm^{-3}$; $N_V = 1.04\times10^{19}\ cm^{-3}$

Q. No.	Question	CO	M. M.
1(a)	Differentiate Between the following. I. Mass and Effective mass of the particle II. Direct and indirect band gap semiconductor III. Compensated and Non compensated semiconductor IV. Degenerate and Non-degenerate semiconductor	CO1	08
	OR		
1'(a)	Describe the following with suitable sketches. I. Density of states function II. Fermi Dirac probability function III. Generation and recombination of carriers IV. Ambipolar transport equation	CO1	08
1(b)	Light shines on silicon at 300 K. The silicon is n-doped at a level of $3\times10^{16}\ cm^{-3}$. The light generates 10^{19} electron-hole pairs per second per cm³. The electron and hole lifetimes are $\tau_n = 4\mu s$ and $\tau_p = 2\mu s$.	CO1	07

Contd....2.

I. What is the minority carrier concentration before the light is turned on?

II. What is the minority carrier concentration after the light is turned on?

III. After the light has been on for a long time, it is switched off. How long does it take after the light is switched off before the minority carrier concentration reaches $1.1p_{no}$?

Q. No.	Question	CO	Marks
2	What is an abrupt p-n junction? Explain its working using energy band diagram. Draw the charge and electric field distribution under no bias, Forward bias and reverse Bias. An abrupt silicon p-n junction consists of a p-type region containing $N_a = 10\times10^{16}\,cm^{-3}$ acceptors and an n-type region containing also $N_a = 10\times10^{16}\,cm^{-3}$ acceptors in addition to $N_d = 10\times10^{17}\,cm^{-3}$ donors. I. Calculate the thermal equilibrium density of electrons and holes in the p-type region as well as both densities in the n-type region. II. Calculate the built-in potential of the p-n junction. at room temp. III. Calculate the built-in potential of the p-n junction at 400K.	CO2	15
	OR		
2'	Explain the working of rectifying metal semiconductor contact using relevant energy band diagrams. What is the ideal Schottky barrier height? How the ohmic contact is made for metal and n-type SC (with metal work function is larger than the SC work function). For a metal- semiconductor contact (contact between tungsten and n-type silicon) , calculate the Schottky barrier height, built in potential and maximum electric field for zero applied bias. For the contact between tungsten and n-type silicon, the values are as follows: $N_d = 10^{16}\,cm^{-3}$ and $\phi_m = 4.55eV$. The value of electron affinity for silicon is $\chi = 4.01eV$.	CO2	15
3	Discuss any five of the following for bipolar junction transistors (BJT). I. Minority carrier distribution in different mode of operations II. Derive the expression of collector current and show the current components III. Emitter current crowding IV. Emitter bandgap narrowing V. Gummel-Poon model VI. Breakdown in BJTs	CO3	15

contd....3.

VII. Complete small signal model for BJT

4(a)	For a MOS capacitor with n-type substrate: show the energy band diagrams for accumulation, depletion, intrinsic and inversion modes of operation (assuming $V_{FB} = 0$). Also draw the charge distribution in different modes of operation.	CO4	6
4(b)	Define surface potential and bulk potential. Derive the expression of threshold voltage of MOS structure.	CO4	4
4(c)	What is the need of accurate MOSFET models? Describe the various circuit models available for MOSFETs. What are the second order effects present in MOSFETs?	CO4	5

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2023-24

B. TECH. (ODD SEMESTER) EXAMINATION

ELECTRONICS ENGINEERING

Fiber Optic Communication

ELE4510

Credits: 04

Maximum Marks: 60 **Duration: Two Hours**

Answer all questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	A step index multimode fiber with a numerical aperture of a 0.20 supports approximately 1000 modes at an 850 nm wavelength. i) What is the diameter of its core? ii) How many modes does the fiber support at 1320 nm?	CO-1	5
1(b)	A multimode graded index fiber exhibits total pulse broadening of 0.1 μs over a distance of 15 km. Estimate: (a) the maximum possible bandwidth on the link assuming no intersymbol interference; (b) the pulse dispersion per unit length; (c) the bandwidth–length product for the fiber.	CO-2	2+2 +2 =6
1(c)	Why polarization maintaining fibre technique is important in fibre optic communication?	CO-2	4
2(a)	An analog optical fiber link employing D–IM has a p–i–n photodiode receiver in which thermal noise is dominant. The system components have the following characteristics and operating conditions: *p–i–n photodiode quantum efficiency: 60%; Effective load impedance for the photodiode 50 kΩ; Preamplifier noise figure 6 dB; Operating wavelength 1 μm; Operating temperature 300 K; Receiver post-detection bandwidth 10 MHz; Modulation index 0.5.* Estimate the required average incident optical power at the receiver in order to maintain an SNR, defined in terms of the mean square signal current to mean square noise current, of 45 dB. [Hint: equations given below used the symbols have usual meaning $P_o \approx \frac{hf}{e\eta m_a^2}\left(\frac{8KTF_n}{R_L}\right)^{\frac{1}{2}}\left(\frac{S}{N}\right)^{\frac{1}{2}} B^{\frac{1}{2}}$]	CO-3	5
2(b)	To design an optical amplification/regeneration system, what are the various stages used. Describe in 1R, 2R, 3R and 4R terminology. **OR**	CO-2	4
2(b')	Describe the working principle of dispersion-modified single-mode fiber methods	CO-2	4

Contd....2.

	for dispersion management in fiber optic communication.		
2(c)	A D–IM analog optical fiber link of length 2 km employs an LED which launches mean optical power of −10 dBm into a multimode optical fiber. The fiber cable exhibits a loss of 3.5 dB km^{-1} with splice losses calculated at 0.7 dB km^{-1}. In addition there is a connector loss at the receiver of 1.6 dB. The p–i–n photodiode receiver has a sensitivity of −25 dBm for an SNR of 50 dB and with a modulation index of 0.5. It is estimated that a safety margin of 4 dB is required. Assuming there is no dispersion–equalization penalty. Perform an optical power budget for the system operating under the above conditions and ascertain its viability.	CO3	6
3(a)	To design a coherent optical transmission system, what are the major practical constraints?	CO-4	5
3(b)	Determine the minimum incoming optical power level required to detect a 400 $Mbits^{-1}$ FSK signal at a BER (*Pe*) of 10^{-10} using an ideal heterodyne synchronous receiver operating at a wavelength of 1.55 μm and given that erfc(4.47)≃2 × 10^{-10}. [Hint: For fully synchronous detection the generalized probability of error expression $P_e = \frac{1}{2} erfc\left(\frac{KZ\eta N_p}{4}\right)^{\frac{1}{2}}$ In the above expression (i) constant K is determined by heterodyne or homodyne detection (ii) constant Z is determined by the modulation scheme (iii) other symbols have usual meanings.]	CO-4	6
3(c)	Compare the receiver sentivities of ASK, FSK and FSK coherent modulation schemes. **OR**	CO-4	4
3(c')	Design of heterodyne receiver is same or different from homodyne receiver in basic coherent receiver configuration. Justify your answer with the help of basic diagram.	CO-4	4
4(a)	Explain the working of add drop multiplexing (ADM) with the help of suitable block diagram. **OR**	CO-5	4
4(a')	Describe the terminology used in SONET/SDH with the help of suitable diagram.	CO-5	4
4(b)	For Design of linear bus topology distribution system for optical netowrk, calculate the total loss for N node system. Each step should be clearly described in the calculation of the total loss. **OR**	CO-5	7

Contd....3.

4(b')	An optical fiber data bus is to be implemented to interconnect nine stations, each separated by 50 m. Multimode fiber cable with an attenuation of 3 dB km^{-1} is to be used along with LED transmitters which launch 200 μW of optical power into their fiber pigtails. The PIN–FET hybrid receivers have a sensitivity of −50 dBm at the desired BER, while the connector losses are 1.1 dB each. The access couplers to be used have a tap ratio or power tap-off factor of 8% together with an insertion loss of 0.9 dB. Finally, the beam splitter can be assumed to have a loss of 3 dB. Determine the safety margin for the system when considering the highest loss terminal interconnection path?	CO-5	7
4(c)	With the help of illustrative diagram, briefly describe the Spectral slicing of LED outputs to form several WDM channels. **OR**	CO-5	4
4(c')	With the help of illustrative diagram, briefly describe the working of DWDM system.	CO-5	4

2023-24
B. TECH. (ODD SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
MOBILE COMMUNICATION
ELE4520

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all questions.
Assume suitable data if missing.
Notations and symbols used have their usual meaning.

Q.No.	Question	CO	M.M.
1(a)	Assume that a cell site uses omnidirectional antenna. (i) Describe how an engineer can determine the actual shape of that cell. (ii) In a cellular radio system, once a cell site is installed and it is functional, does the shape of that particular cell remain absolutely fixed, or the shape may change with passing time? Justify your answer.	(CO1)	[5]
1(b)	In cellular radio, explain the factors which affect the co-channel interference.	(CO1)	[5]
1(c)	What are three types of hand overs in a mobile communication network? Which of them is simplest and which of them is most complex, and why?	(CO1)	[5]
	OR		
1(c')	What is Sectoring? How does Sectoring affect the mobile network design?	(CO1)	[5]
2(a)	If a transmitter produces 50W power, express the transmit power in units of dBm and in dBW. If 50 W is applied to a unity gain antenna at 900 MHz carrier frequency, find received power in Watts and in dBm at 100 m free space distance from the transmit antenna. Assume unity gain receive antenna.	(CO2)	[5]
2(b)	Does the choice of carrier frequency influence the design of mobile communication network? Justify your answer in detail.	(CO2)	[5]
2(c)	Calculate the average fade duration at frequency of 900 MHz if relative velocity between the transmitter & receiver is 120 kmph and fade margin is 10 dB. Give your comments on the value obtained and its significance.	(CO2)	[5]
	OR		
2(c')	What is meant by the terms 'coherence bandwidth' and 'coherence time'? Explain whether or not they are dependent on each other, and why? Explain the usefulness and relevance of these terms in modern wireless networks?	(CO2)	[5]

Contd….. 2.

3(a) Assume that digital data is being transmitted on flat fading channel (FFC). Describe briefly the issues involved in each of the three cases: (i) Unknown user data on known FFC; (ii) Known training data on unknown FFC; (iii) Unknown data over unknown FFC. (CO3) [5]

3(b) What is meant by catastrophic failure during a deep fade and why does it occur? Describe briefly how the system can recover after such a failure. (CO3) [5]

3(c) How does an OFDM based mobile radio system overcome the problems associated with earlier systems like 2G / 3G systems? (CO3) [5]

OR

3(c') Describe briefly, with the help of suitable diagrams, how some features of OFDMA are used to make the system more adaptive to user requirements. (CO3) [5]

4(a) In a GSM transceiver, are the transmitter and receiver of any one link active at the same time? Give reason(s) for your answer? (CO4) [5]

OR

4(a') Show the calculations which give the channel coder output bit rate of one voice channel in a GSM system. (CO4) [5]

4(b) Is equalization necessary in a GSM system? Justify you answer with details. (CO4) [5]

OR

4(b') Differentiate between the features of LTE Release 8 and LTE Release 10. Calculate the typical values of spectral efficiency in each of these standards: (i) GSM (2G), (ii) UMTS (3G), (iii) HSPA+ (3.5G), (iv) LTE (4G). (CO4) [5]

4(c) Give an overview of 5G system concept. Describe briefly each of the three generic services in 5G. (CO4) [5]

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2023-24

B. TECH (ODD SEMESTER) EXAMINATION
ELECTRONICS ENGINEERING
ELE4620 (DIGITAL IC DESIGN)

Maximum Marks: 60 **Credits: 04** **Duration: Two Hours**

Answer all questions. Assume suitable data if missing. Notations and symbols used have their usual meaning.

Q.No	Question	CO	M.M.
1	**a)** Find the final value of the voltage V_{OUT} for the various switch logics shown in Fig. 1. Assume that $V_{TN}=\|V_{TP}\|=0.3V$, and that the output capacitor, C_L, is initially discharged. Ignore sub-threshold conduction and body effect. All middle nodes are discharged initially. **b)** For the Fig. 2, find the final output voltage value when the input is high, $V_{IN}=1.2V$. After the output reaches its final value, a 1.2 V to 0 V step is applied to the input, V_{IN}. Determine the energy consumed in the transistors, $E_{1\to0}$, from Fig. 2 during the transition. The load capacitor C_L is 10 fF. Ignore any other parasitic capacitors except C_L. **OR** **b')** For Fig.3, the initial output voltage, V_{OUT}, is discharged, $V_{OUT}=0$. Find the energy dissipated in the transistor during the first 0→ 1 transition, **first $E_{0\to1}$**. Then, after the output reaches its final value, a 1.2V to 0 step is applied to the input, followed by the second 0 to 1.2V step. Find the energy dissipated in the transistor in the first 1 → 0 transition, **first $E_{1\to0}$**, and the second 0→ 1 transition, **second $E_{0\to1}$**. The load capacitor C_L is 10 fF.	(CO1)	[7.5+7.5 =15]
2	**a)** In order to drive a large capacitance (C_L=20 pF) from a minimum size gate (with input capacitance C_{IN}=10 fF), there is a need to introduce buffer stages as shown in Fig. 4. Assume that the intrinsic propagation delay of a minimum size inverter, t_{inv}, is 70 psec. Also assume that the input capacitance of a gate is proportional to its size, and there is no diffusion capacitance of inverter, $\gamma=0$. Determine the sizing of the two additional stages that will minimize the propagation delay. **b)** The circuits of Fig. 5 show four different implementations of a digital inverter, whose output is connected to a capacitor. Assume $V_{TN}=\|V_{TP}\|=0.3V$, and the output capacitor, C_L, is initially discharged. Ignore sub-threshold conduction and body effect. A. Which one(s) of the circuits consumes static power when the input is high (V_{IN}=1.2V)? B. Which one(s) of the circuits consumes static power when the input is low (V_{IN}=0V)? C. V_{OL} of which circuits(s) is 0V?	(CO2)	[7.5+7.5 =15]
3	**a)** We know that dynamic power consumption for the complementary CMOS design is given by, $P_{dyn} = aC_{out}V_{dd}^2f$, where '$a$' is an activity coefficient. Calculate the activity co-efficient for each of the following gates (assume all input combinations occur with equal probability). A. Two-input NOR gate B. Three-input NAND gate C. Two-input XOR gate **b)** Implement the XOR gate using one stage of dynamic logic using an NMOS pull-down network. Assume that you have complementary inputs. **OR** **b')** Implement the XOR gate using one stage of dynamic logic using an PMOS pull-up network. Assume that you have complementary inputs.	(CO2)	[7.5+7.5 =15]
4	**a)** Give the schematic of CMOS SR Latch based on two input NAND gates. **b)** Explain the functionality six-transistor CMOS SRAM cell using its circuit diagram. **OR** **b')** 1-T DRAM cell (shown in Fig. 6) connected in series with a capacitor. For a read, the bit line is precharged to V_{DD}/2 by a clocked precharge circuit. Then, the access transistor is turned on by applying V_{DD} to the word line. A write is performed by applying V_{DD} or GND to the bit line and	(CO3)	[7.5+7.5 =15]

contd...2

V_{DD} to the word line. Assume that V_{To}= 0.4 V, γ = 0.3 $V^{1/2}$, $|2\Phi_F|$ = 0.6 V. Assume C_{BL}=450 fF and C_S= 50 fF

A. Find the maximum voltage across the storage capacitor C_s after writing a 1 into the memory cell (i.e., bit line is driven to V_{DD} = 2.5V).

B. Ignoring leakage currents, find the voltage on the bit line when this "1" is read from the memory cell.

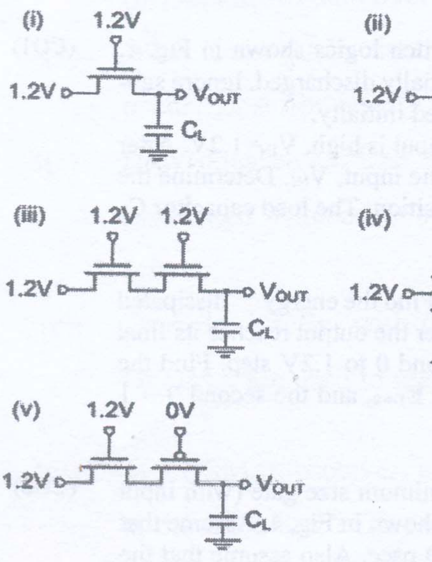


Fig. 1

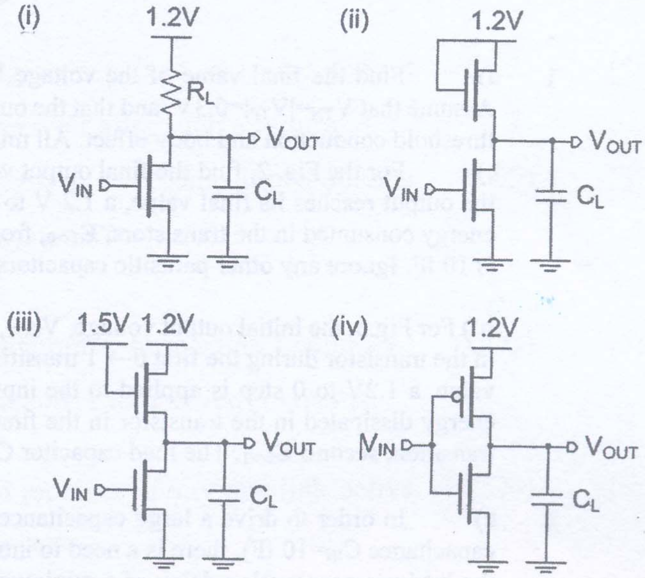


Fig. 5

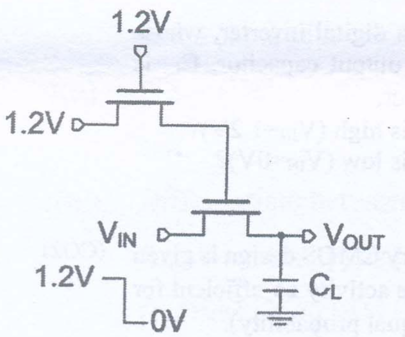


Fig. 2

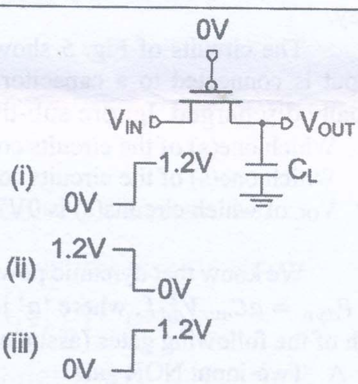
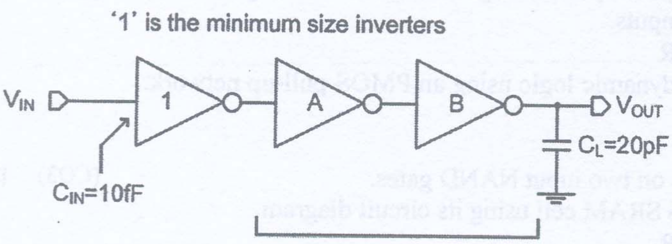


Fig. 3



Added Buffer Stages

Fig. 4

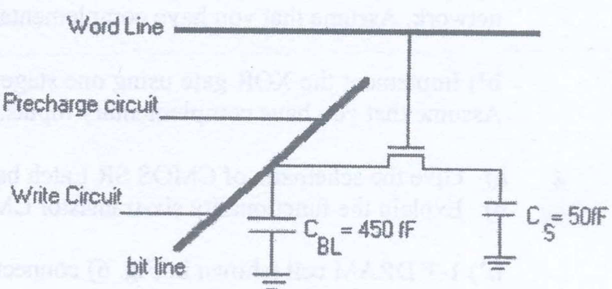


Fig. 6