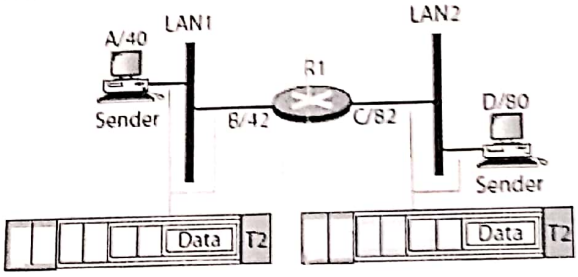
INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH
An Institute of National Importance under MoE
Saloh, Una– 177 209
Website: www.iiitu.ac.in

School of Electronics
CURRICULUM: IIITUGECE22
End Semester Examination
December 04, 2023
Time: 9:00 AM to 12:00 PM

Degree	B. Tech.	Branch	ECE
Semester	V		
Subject Code & Name	ECPE11: Data Communication and Networks		
Time: 180 Minutes	Answer All Questions	Maximum: 100 Marks	

Sl. No.	Question	Marks
1.a	In Fig. 1, assume that the communication is between a process running at computer A with port address *i* and a process running at computer D with port address *j*. Create the packets and frames at the network, data link, and transport layer for each hop. At each transmission link address is mentioned as X/Y where X-Logical address and Y-Physical Address.  Fig. 1	5
1.b	How do the layers of the Internet model correlate to the layers of the OSI model? Mention the protocols with full names at each layer in TCP/IP model.	5 (2+3)
1.c	The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with -0.3 dB/km has a power of 2 mW, what is the power of the signal at 5 km?	5
1.d	Discuss the basic network topologies and cite an advantage of each topology.	5
2.a	Find the bandwidth for the following situations if a 5 KHz voice signal is to be modulated. i) AM ii) FM (Modulation index=5)	5 (2+3)
2.b	The telephone line has 4 KHz bandwidth. Calculate the maximum number of bits that can be sent using each of the following techniques. Let d =0. i) ASK ii) QPSK iii) 16-QAM iv) 64-QAM	5
2.c	Compare and contrast PCM and DM with respect to transmitter diagrams.	5

2.d	List three different techniques in serial transmission and explain the differences.	5
3.a	A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is x^3+1. Generate the actual code word that would be transmitted.	5
3.b	Encode a binary word 11001 into the even parity hamming code.	5
3.c	In Select-Repeat ARQ every 5th packet is lost and it is required to send total 10 packets. How many total transmissions and retransmissions it will take to send all the packets if the window size is 5?	5
3.d	In SR protocol, suppose frames through 0 to 4 have been transmitted. Now, imagine that 0 times out, 5 (a new frame) is transmitted, 1 times out, 2 times out and 6 (another new frame) is transmitted. At this point, what will be the outstanding packets in sender's window?	5
4.a	i) Find the class of following IP*v*4 addresses: a. 11000001 10000011 00011011 11111111 b. 14.23.120.8 c. 252.5.15.111 ii) Expand the IP*v*6 address 0:15::1:12:1213 to its original.	5 (3+2)
4.b	Illustrate direct and indirect packet delivery with examples.	5
4.c	Compare and contrast all forwarding techniques using network examples along with routing tables.	5
4.d	Devise a Network Topology plan for the amount of subnets needed, and where it is required to assign the IPv4 addresses within each subnet. i) Divide the 172.16.10.0/24 network into eight subnets. ii) What is the value of the new subnet mask? iii) How many usable host addresses exist per subnet? iv) Fill in the following table with the resulting subnets (from step (i) above):	5
5.a	Differentiate the TCP and UDP headers with clear illustrations.	5
5.b	How is the Quality of Service (QoS) of a network measured? Explain the techniques used to improve the QoS.	5
5.c	Describe the use of DNS with an illustration. Explain different algorithms used in DNS that serve the purpose.	5
5.d	Identify and Interpret various protocols involved in electronic mail transfer.	5

Subnet Number	Network Address	Usable Host Address Range	Broadcast Address
1.			

**** GOOD LUCK ****

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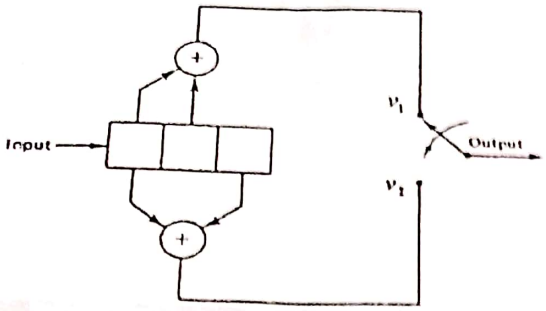
AY 2023-24
School of Electronics
CURRICULUM: IIITUGECE22
End Semester Examination
06 Dec.'2023 (9:00 – 12:00 hrs)

Degree	B. Tech.	**Branch**	ECE
Semester	V		
Subject Code & Name	ECPE31: COMMUNICATION THEORY		
Time: 180 Minutes	**Answer All Questions**		**Maximum: 100 Marks**

Q. No.		Question	Marks
1.	a.	(i) Plot PMF, PDF and CDF for a Random Variable X which is specifying no. of heads in the experiment of Tossing a coin twice. (ii) A gambler flips a fair coin three times. A random variable X representing the winnings is defined as follows: Lose 1 ₹ if no heads in three flips; Wins 1 ₹, 2 ₹, and 3 ₹ if 1, 2, or 3 heads are obtained, respectively. Show how elements of S map to values of X. What are the probabilities of the various values of X?	(3+2)
	b.	An intercom system master station provides music to six hospital rooms. The probability that any one room will be switched on and draw power at any time is 0.4. When on, a room draws 0.5 W. (i) Find and plot the density and distribution functions for the random variable "power delivered by the master station". (ii) If the master-station amplifier is overloaded when more than 2 W is demanded, what is its probability of overload?	(3+2)
	c.	(i) A random variable X has a probability density $f_X(x) = \begin{cases} \pi/16 \cos[\pi x/8]; -4 \le x \le 4 \\ 0; otherwise \end{cases}$ Find: its mean value $\overline{X}$, its second moment $\overline{X^2}$, and its variance. (ii) Find the mean value of the function $g(X) = 4X^2$ and $g(X) = 4X^4$.	(3+2)
	d.	A random process X is given by $X(t) = A\cos\{\omega_0 t + \Phi\}$ where A and ω_0 are constant and Φ is random variable; which is uniformly distributed in the interval $(0, 2\pi)$. (i) Find whether given random process is WSS or not?	(3+2)

		(ii) If same random process is considered as random variable X uniformly distributed on the interval (-5, 15). Another random variable is formed. Find E[Y].	
2.	a.	(i) Prove that total information is the sum of individual information. (ii) Derive the relationship between entropy and mutual information.	(2+3)
	b.	(i) Consider a binary memoryless source X with two symbols x_1 and x_2. Show that H(X) is maximum when both x_1 and x_2 are equiprobable. (ii) Calculate the average information content in the English language, assuming that each of the 26 characters in the alphabet occurs with equal probability.	(3+2)
	c.	(i) For an AWGN channel with 4kHz bandwidth and noise power spectral density $N_0/2 = 10^{-12}$ W/Hz the signal power required at the receiver is 0.1mW. Calculate the capacity of this channel. (ii) Explain Jensen's inequality with application.	(2+3)
	d.	(i) Consider a digital security system as source having two symbols: Green LED ON as functioning properly and Red LED ON as situation of danger. The Green LED ON duration is 0.2 s. The Red LED ON duration is 3 times the Green LED ON duration. The probability of the Green LED ON 's occurring is twice that of the Red LED ON, and the time between symbols is 0.2 s. Calculate the information rate of the digital security system as source. (ii) Explain the chain rule for entropy.	(3+2)
3.	a.	(i) Find the channel capacity of the binary erasure channel. (ii) Show that the channel capacity of an ideal AWGN channel with infinite bandwidth $C_\infty = 1.44\left(\frac{S}{\eta}\right)$ where S is the signal power and $\eta/2$ is the power spectral of white gaussian noise.	(2+3)
	b.	An analog signal having 4 kHz Bandwidth is sampled at 1.25 times the Nyquist rate, and each sample is quantized into one of 256 equally likely levels. Assuming the samples to be statistically independent. (i) What is the information rate of this source? (ii) Can the output of this source have transmitted without error over an AWGN channel with a BW of 10 kHz and S/N ratio of 20 dB. (iii) Find the bandwidth required for an AWGN channel for an error free transmission of the output of this source if S/N ratio is 20 dB.	(1+2+2)
	c.	A DMS X has five symbols x_1, x_2, x_3, x_4, and x_5 with respective probabilities 0.2, 0.15, 0.05, 0.1, and 0.5. (i) Construct a Shannon-Fano code for X, and calculate the code efficiency. (ii) Repeat (i) for the Huffman code.	(3+2)
	d.	Consider the transmission of a message "went." comprising a string of characters with probability 'e' with 0.3, 'n' with 0.3, 't' with 0.2, 'w' with 0.1, '.' with 0.1. Encode the message with arithmetic Coding. Write its arithmetic Code word and Tag value.	(5)
		(i) Let C be a (7, 4) cyclic code with $g(x) = 1 + x + x^3$. Find a generator matrix G for C and find the code word for d = (1010). (ii) Consider binary symmetric channel having $p(m_0) = 0.7$ and $p(m_1) = 0.3$. Determine the decoding decision when MAP and ML decoding is used respectively.	(2+3)

	b.	Consider a (7, 4) linear block code with the parity-check matrix H given by $$H = \begin{bmatrix} 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$ (i) Construct code words for this (7, 4) code. (ii) Show that this code is a Hamming code. (iii) Illustrate the relation between the minimum distance and the structure of the parity-check matrix H by considering the code word 0101100.	(1+2+2)
	c.	For a (6, 3) systematic linear block code, the three parity-check bits c_4, c_5, and c_6 are formed from the following equations: $c_4 = d_1 \oplus d_3$; $c_5 = d_1 \oplus d_2 \oplus d_3$; $c_6 = d_1 \oplus d_2$ (i) Write down the generator matrix G. (ii) Construct all possible code words. (iii) Suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bits.	(1+2+2)
	d.	Consider the convolutional encoder shown in Fig. 1. (i) Find the impulse response of the encoder. (ii) Find the output code word if the input sequence is all 1's (111111...). (iii) Discuss the result of (ii).  Fig. 1: Convolutional Encoder	(2+2+1)
	a.	(i) Two resistors 20 kΩ and 50 kΩ are at room temperature (290 °K). Calculate the thermal noise for each resistor, for two resistors in series and for two resistors in parallel, if the bandwidth of 100 kHz is specified. (ii) An Amplifier with an output signal voltage of 4V, an output Noise voltage of 0.005V and an input and output resistance of 50 ohm. Determine the signal to Noise power ratio.	(2+3)
	).	(i) Determine the internal noise power of a microwave amplifier operating with a bandwidth of 500 MHz and a specified noise figure of 2.5 dB. (ii) The amplifier is shown in Fig. 2. The operating temperature is 27°C. The noise is contributed only by the input resistance. Determine the rms noise voltage at output.	(1+2+2)

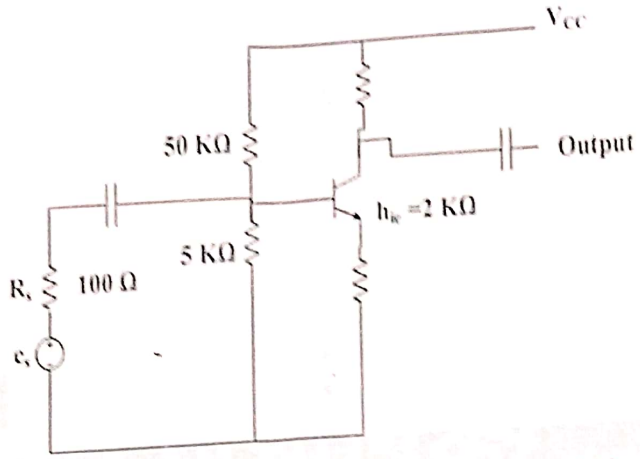


Fig. 2: Amplifier having 100 Voltage gain at 4 MHz Bandwidth

(iii) Explain the FET noise model in brief.

c. (i) An amplifier has a noise figure of 4 dB, a bandwidth of 500 K Hz and an input resistance of 500 Ω. Calculate the input signal power needed to yield an output SNR=1 when the amplifier is connected to a signal source of 502 at 290 K. (3+2)

(ii) Define and differentiate flicker noise and shot noise.

d. The Fig. 3 shows a typical microwave receiver used in satellite communications. Evaluate the following: (1+2+2)

(i) the overall noise-figure of the receiver

(ii) the overall equivalent temperature of the receiver.

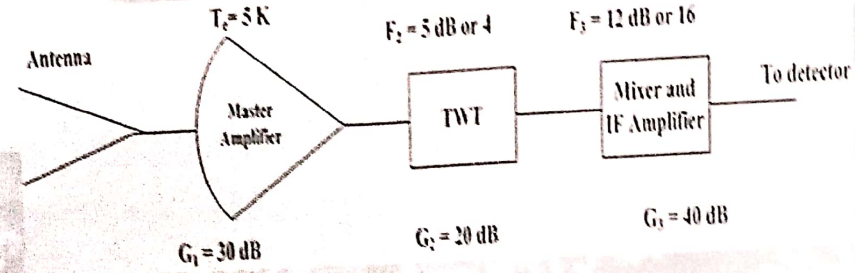


Fig. 3: Block diagram of microwave receiver

Assume that ambient temperature T=17° C.

(iii) Calculate rms value of thermal noise voltage in RC circuit.

*****All The Best*****

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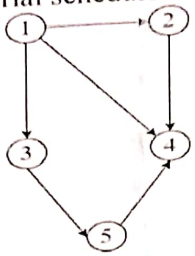
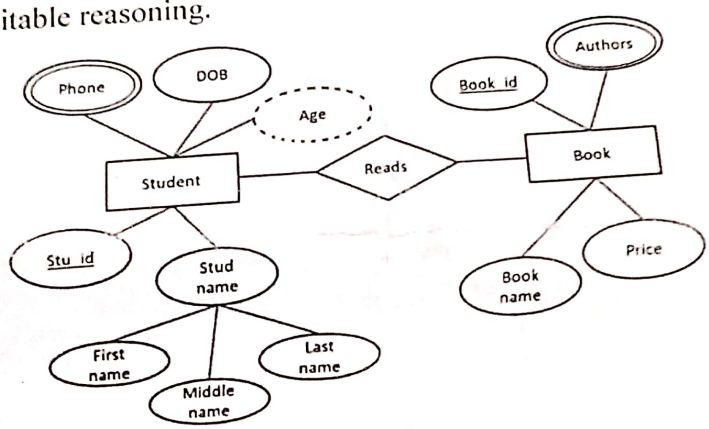
AY 2023-24
SCHOOL OF COMPUTING
CURRICULUM: HITUGCSE22
End Semester Examination
07, Dec.'23

Degree	B. Tech.	Branch	CSE/IT/ECE
Semester	V		
Subject Code & Name	CSSE21 Relational Database Management Systems		
Time: 180 Minutes	Answer All Questions		Maximum: 100 Marks

Sl. No.	Question	Marks
1.a	Let n_B denotes the memory buffer. Let R be a relation with n_R initial runs. Given that $n_B - 1 < n_R$, what is the smallest x number of memory buffer n_B required such that R can be sorted in two passes using a sort-merge join? Write down the calculation and justify it.	5
1.b	A schedule S of n transactions T1, T2, ..., Tn is said to be a complete schedule if the following conditions hold: 1. The operations in S are exactly those operations in T1, T2, ..., Tn, including a commit or abort operation as the last operation for each transaction in the schedule. 2. For any pair of operations from the same transaction Ti, their relative order of appearance in S is the same as their order of appearance in Ti. 3. For any two conflicting operations, one of the two must occur before the other in the schedule. Is it okay to relax (remove) the condition 3 for the definition of complete schedule? If yes then give an example else state a valid reason.	5
1.c	What are different methods for implementing JOIN operation in RDBMS? Explain each method using suitable examples.	5
1.d	Explain the difference between recovery techniques based upon deferred update and immediate update. Also, explain the use case with suitable example where the former is more suitable than the later and vice versa.	5
2.a	Explain in detail about Geographic Information Systems (GIS) databases. Also, discuss their applications.	5
2.b	What is a Deductive Database? What are the applications of Deductive Databases in Computer Science?	5
2.c	Explain different type of constraints applicable to relational databases with suitable examples.	5
2.d	What is the difference between deadlock avoidance and deadlock detection? Also, explain how to tackle deadlock problem in the databases when the size of the database is very large.	5
3.a	Consider the following Schema: Supp(SAD, Name, phone, address)	5

	Prod(PID, name, color, year) Info(SAD, PID, price) SAD means Supplier Aadhar ID and PID means Product ID. Write a relational algebra expression for the following queries: i. Find names of all products with year 2023. ii. Find the name and phone no. of all the suppliers who supplied T-shirts of white color.	
3.b	Is corresponding schedule conflict serializable to the precedence graph shown in Figure 1? If yes list down all equivalent serial schedules.  **Figure 1**	5
3.c	What will be relational schema corresponding to the ER diagram given in Figure 2? Explain with suitable reasoning.  **Figure 2**	5
3.d	Explain how wait-for-graphs are used to detect deadlocks. Also, explain and state reasons why wait-for graph is more suitable for smaller databases compared to the large databases.	5
4.a	Explain in detail the propagation of privileges in Discretionary Access Control with suitable example. Also, explain its advantages and disadvantages.	5
4.b	Is $\sigma_c\ (R1 \bowtie R2) = \sigma_c(R1) \bowtie R2$, where c uses only the attributes of $R1$ and $\bowtie$ is left outer join? Is $\sigma_c(R1) \bowtie R2$ more efficient to use as compared to the $\sigma_c\ (R1 \bowtie R2)$? Please provide a reason for both cases.	5
4.c	What are mobile databases? Explain in detail the mobile computing architecture using suitable diagram.	
4.d	What is flow control? What are security problems associated with flow control?	
5.a	What is polyinstantiation in Mandatory Access Control. How does it ensure the security of data?	
5.b	Consider the schedule given in the Table 1. What will be the resultant value of variables X and Y. Assume initial value of X is 55 and Y is 23. Show all steps when X changes. **Table 1**	

T1	T2
READ_LOCK(Y)	
READ_ITEM(Y)	
UNLOCK(Y)	

	READ_LOCK (X)
	READ_ITEM(X)
	UNLOCK(X)
	WRITE_LOCK(Y)
	READ_ITEM(Y)
	Y = X+Y
	WRITE_ITEM(Y)
	UNLOCK(Y)
WRITE_LOCK(X)	
READ_ITEM(X)	
X=X+Y	
WRITE_ITEM(X)	
UNLOCK(X)	

5.c Consider the log table shown as Table 2. Is it possible to reorder the statements of Table 2 such that there is no need to roll back transaction T2 and T3 during the recovery process (deferred update)? Explain the answer in both cases.

Table 2

[start_Transaction,T3]
[read_item, T3, C]
[write_item, T3, B, 15,12]
[start_Transaction, T2, B]
[write_item, T2, B, 12,18]
[start_Transaction, T1]
[read_item, T1, A]
[read_item, T1, D]
[write_item, T1,D,20,25]
[read_item, T2, D]
[write_item, T2, D, 25,26]
[write_item, T3, A]
System crash

5.d Suppose that there are two tables *STUDENT* and *SUBJECT*, given below as Table 3 and 4, respectively. *Roll No.* is the primary key in Table 3 and is being referenced by *Roll No.* of Table 4. Explain referential integrity of a database and also explain how the referential integrity be preserved for following tables if a user deletes the record of a student named Smith from the Table 3.

Table 3

Roll No.	Name	Course
1	John	MCA
2	Smith	M.Tech.
3	Shane	B.Tech.
4	Ricky	MBA

Table 4

Roll No.	Sub Code	Sub Name
1	001	DBMS
1	005	SQL
2	007	DS
3	002	DAA
2	001	DBMS
4	005	SQL
3	001	DBMS
2	004	ML