KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 3rd Year 2nd Term Examination, 2016

Department of Electronics and Communication Engineering

ECE 3201

(Information Theory)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What do you mean by information? How to measure information? (07)
   b) "The greater the uncertainty of a message, the more of information it carries" – Justify the statement. (08)
   c) Illustrate the "Shanon Paradigm" model to transmit a message from transmitting end to receiving end. (10)
   d) A random experiment consists of drawing one card from a pack of 32 playing cards. Lets 'X' be the discrete random variable define as: (10)

$$\{X = \sqrt{3}\} \Leftrightarrow \{\text{The drawn card is red}\}$$
$$\{X = 7\} \Leftrightarrow \{\text{The drawn card is a spade}\}$$
$$\{X = \log\pi\} \Leftrightarrow \{\text{The drawn card is a diamond}\}$$

   Find the average no. of bits required to represent the possible values of X.

2. a) What is conditional entropy? Let the joint distribution of X, Y in tabular form with the marginals: (20)

$P(x, y) =$

y \ x	1	2	P_y
1	1/4	1/2	3/4
2	1/4	0	1/4
P_x	1/2	1/2	

   Find $H(X, Y)$.
   b) What do you mean by reduction of channel? What is the necessary and sufficient condition for channel reduction? (09)
   c) Explain the channel capacity of a discrete memoryless channel. (06)

3. a) Clarify the binary erasure channel and find its capacity. (08)
   b) What is the information capacity of parallel Gaussian channel? (13)
   c) Define coherence time and coherence bandwidth of the channel. Determine the appropriate channel model for an airplane to airplane communication link in which there is a direct signal propagation path, and a secondary propagation resulting from signal scattering due to the surrounding ground terrain. The secondary path has a propagation delay of $\tau_0 = 10$ μs relative to the propagation delay of the direct path. The signal BW is $W = 50$ KHz. (14)

4. a) State and explain Jensen's inequality. (07)
   b) Given any two probability measures P and M on a common finite alphabet probability space, then prove that $D(P \| M) \geq 0$ with equality if and only if $P = M$. (13)
   c) State and explain the first-order Markov chain for a discrete stochastic process. (10)

d) Evaluate the communication equivalence classes of the following state diagram: (05)

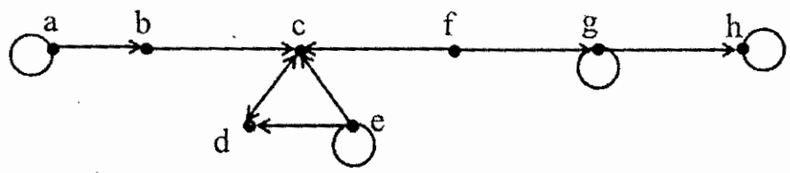


Fig. 4(d)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What are the requirements to design an efficient coding scheme for a single random message? (06)

b) "A D-ary code (C_1, ... C_X) prefix free, iff in its D-ary tree every code word is a leaf" – Justify the statement with suitable examples. (09)

c) Prove that the no. of leaves x and their depths $l_1, l_2, \ldots\ldots l_x$ in a D-ary tree satisfy: (10)

$x = 1+N(D-1)$, $\sum_{i=1}^{x} D^{-l_i} = 1$, where, x is the no. of nodes (including the root).

d) Design binary Huffman code for the random message 'U' with the probabilities p_1=0.4, p_2=0.1, p_3=0.1, p_4=0.1, p_5=0.1, p_6=0.1, p_7=0.1 and also compute their performance. (10)

6. a) Show that the entropy of a proper message set $H(v)$ for an r-ary DMS u is $H(v) = H(u).E[M]$, where symbols have their usual meanings. Also use an example to illustrate the above entropy theorem. (11)

b) Consider a ternary DMS that emits an independent and identically distributed (IID) sequence of ternary random messages with the following probabilities: (12)

$P(a) = 0.5$, $P(b) = 0.3$, and $P(c) = 0.2$

The encoded source symbols are based on an arithmetic code of block length $M = 3$. Determine the decoded source sequence if the first couple of digits of the received sequence are as follows: 10001110100 .....

c) Consider a binary memoryless source (BMS) with the probabilities $P(0)$=0.6 and $P(1)$ =0.4. Construct a binary block code of length 3 by using Tunstall's algorithm. (12)

7. a) Define the following terms: (12)
(*i*) Compression scheme with memory, (*ii*) Adaptive Huffman coding, and (*iii*) Recency rank calculator.

b) Construct the first and second Elias codes for the positive integers extend from 1 to 10. (11)

c) Consider a binary source $U_k \in \{A, B\}$, the window size $w = 4$, $l_{max} = 8$, $D = 2$. Design LZ 77 codes for the source that produces the following sequences: (12)

ABBABBABBBAABABA

8. a) Define the following terms: (06)
(*i*) Hamming distance, (*ii*) Coding gain, and (*iii*) Bandwidth expansion ratio.

b) Consider the generator matrix G for an (m, k, d, N_d) linear block code given bellow: (14)

$$G = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

(i) Specify the values of code parameters m, k, d and N_d.

(ii) Assume that the uncoded binary pulse amplitude modulation (PAM) system has the error probability;

$Q\left(\sqrt{\frac{2E_b}{N_0}}\right)$, where E_b is the energy per bit and $N_0/2$ is the noise power spectral density (PSD). Find the union bound estimate for the error probability per bit P_b in term of E_b/N_0 for the above code.

(iii) Compute the coding gain (numerically in dB) for this block code at $P_b=10^{-4}$.

NOTE: for numerical computation, you may find some of the following useful equations:

$$Q\left(\sqrt{\frac{2E_b}{N_0}}\right)=10^{-4} \Rightarrow \frac{E_b}{N_0}\cong 8.4\,dB \qquad \frac{4}{3}Q\left(\sqrt{\frac{3E_b}{N_0}}\right)=10^{-4} \Rightarrow \frac{E_b}{N_0}\cong 6.8\,dB$$

$$\frac{4}{3}Q\left(\sqrt{\frac{4E_b}{N_0}}\right)=10^{-4} \Rightarrow \frac{E_b}{N_0}\cong 5.6\,dB \qquad \frac{7}{3}Q\left(\sqrt{\frac{4E_b}{N_0}}\right)=10^{-4} \Rightarrow \frac{E_b}{N_0}\cong 5.9\,dB$$

c) Construct the following figure as the structure of a convolutional encoder with constraint length 3 and the shift register. (15)

(i) What is the rate of this convolution code?

(ii) What is the generator matrix of this code?

(iii) Draw the state transition diagram of this code.

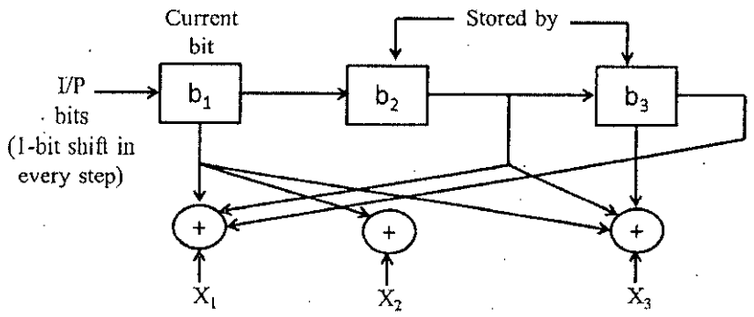


Fig. 8(c)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 3rd Year 2nd Term Examination, 2016

Department of Electronics and Communication Engineering

ECE 3203

(Digital Signal Processing)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is correlation? Determine the autocorrelation values of the input signal and impulse response, $x(n)=\{1, 2, 3, 4\}$ and $h(n)=\{1, 0, 0, 1\}$. (10)
   b) How does the FFT algorithm reduce the complexity of DFT process from N^2 to $N\log_2 N$? (08)
   c) Find the inverse DFT of $x(k)=\{1, 2, 3\}$. (07)
   d) Determine DFT (8-point) for a continuous time signal, $x(t) = \cos(2\pi ft)$ with $f = 50$ Hz using DIT-FFT algorithm. (10)

2. a) What is FIR filter? Differentiate FIR and IIR filter mathematically. (06)
   b) Determine the magnitude response and show that the phase and group delays are constant for the following FIR filter: (12)

$$H(z) = \sum_{n=0}^{M-1} h(n) z^{-n}, \text{ where length, M=11.}$$

   c) What are the effects of truncating an infinite Fourier series into a finite series? (05)
   d) Use the Fourier series method of designing an FIR filter (high-pass) to approximate the ideal specifications given by: (12)

$$H(e^{j\omega}) = \begin{cases} 0, & \text{for } |f| < f_p \\ 1, & \text{for } f_p \le |f| \le F/2 \end{cases}$$

3. a) What is FIR half-band digital filter? (04)
   b) What is rectangular window function? Obtain its frequency domain characteristics. (08)
   c) In what way Kaiser window is superior to other window functions? Explain the design procedure of an FIR high-pass filter using Kaiser window. (11)
   d) A filter is to be designed with the following desired frequency response: (12)

$$H_d(e^{j\omega}) = \begin{cases} 0; & -\pi/4 \le \omega \le \pi/4 \\ e^{-j2\omega}; & \pi/4 \le \omega \le \pi \end{cases}$$

   Determine the filter coefficients $h(n)$ if the rectangular window function is used for $0 \le n \le 4$.

4. a) State and explain alternation theorem. (10)
   b) What is frequency resolution? In terms of frequency resolution, which non-parametric method is the most efficient? Explain with performance analysis of non-parametric power spectrum estimation. (13)
   c) What are the basics of AR, MA and ARMA models of power spectrum estimation? (07)
   d) Explain that the periodogram of power spectrum estimate is consistent. (05)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What is digital signal processing (DSP)? What are the applications of DSP? (08)

   b) Compute the convolution $y = h * x$ of the filter and input signals: (10)

   $$h = [1, 2, 3, 4], x = [1, 2, 3, 4, 5, 6, 7, 8]$$

   using the overlap-add methods of block convolution with length 5 input block.

   c) Given the second order transfer function: (12)

   $$H(z) = \frac{2 - 0.4z^{-1} - 0.6z^{-2}}{1 + 2z^{-1} - 0.5z^{-2}}$$

   Realize the structure in (*i*) direct form II, (*ii*) cascade form, and (*iii*) parallel form.

   d) Determine the I/O difference equation of the IIR filter has the following causal periodic impulse response: (05)

   $$h(n)=\{2, 3, 4, 5,\ 2, 3, 4, 5,\ 2, 3, 4, 5, \ldots\ldots\}$$

6. a) What is recursive and non-recursive digital filter? What are the advantages of IIR filter over FIR filter? (10)

   b) Design a first order low-pass digital filter with -3dB frequency of 1KHz and sampling frequency of 8KHz. Use (*i*) Bilinear transformation method; (*ii*) Euler approximation method; and (*iii*) Impulse invariant method. (15)

   c) A prototype low-pass filter has the system's response: (10)

   $$H(s) = \frac{1}{s^2 + 2s + 1}$$

   Obtain a band-pass filter with $\Omega_0 = 2$ rad/s, $Q = 10$, $\Omega_0^2 = \Omega_1.\Omega_2$ and

   $$Q = \frac{\Omega_0}{\Omega_2 - \Omega_1}$$

7. a) Describe the coefficient of quantization effects in direct form realization of IIR filters. (15)

   b) The output of an A/D converter is applied to a digital filter with the system function. (10)

   $$H(z) = \frac{0.5z}{z - 0.5}$$

   Find the output noise from the digital filter, when the input signal is quantized to have eight bits.

   c) A digital system is characterized by the difference equation, $y(n) = 0.9y(n\text{-}1)+x(n)$ with $x(n)=0$ and initial condition $y(-1)=12$. (10)

8. a) What is short term Fourier transform (STFT)? What are the drawbacks of STFT? (07)

   b) What is wavelet? What are the properties of wavelet? (08)

   c) What are the procedures for computation of CWT for signal processing? (08)

   d) Describe the sub band coding algorithm for sub band system in signal processing applications. (12)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B. Sc. Engineering 3rd year 2nd Term Examination, 2016

Department of Electronics & Communication Engineering

ECE-3205

(Digital Communications)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Briefly illustrate a digital communication system with the aid of its fundamental block diagram. List the advantages of digital communication over analog counterpart. 09
   b) State and prove the sampling theorem in PCM process. What is the difference between natural and flat-top sampling? 11
   c) Explain the generation and reconstruction processes of PWM signal. 09
   d) How does the aliasing effect arise in a PCM system? How can it be avoided? 06

2. a) Explain the approach to signal prediction in a differential pulse code modulation (DPCM) system. 10
   b) Explain the function of a compandor to improve the performance of PCM systems. 06
   c) What is eye pattern? What are the useful information an eye pattern provide? Explain. 08
   d) The output SNR of a 10-bit PCM ($n = 10$) was found to be 30 dB. The desired SNR is 42 dB. It was decided to increase the SNR to the desired value by increasing the number of quantization levels L. Find the functional increase in the transmission bandwidth required for this increase in L. 11

3. a) Are NRZ codes capable of self-synchronization? Why? Mention the major advantages of HDB3 code over other codes. 10
   b) Explain the noises associated with DM. How can you reduce these effects? Compare the performance of DM over PCM. 10
   c) Briefly illustrate the DPCM process with the aid of block diagram. 05
   d) In a PCM system, the bit error rate is 10^{-4}. Assume that the peak signal to noise ratio on the recovered analog signal needs to be at least 30 dB. 10
      i) Find the minimum number of quantizing steps that can be used to encode the analog signal into a PCM signal.
      ii) If the original analog signal had an absolute bandwidth of 2.7 kHz, what is the null bandwidth of PCM signal for the polar NRZ signaling case?

4. a) Briefly describe the synchronous and asynchronous transmission with their frame formats. 10
   b) Write a short note on North American and CCITT recommended digital TDM hierarchy. 10
   c) Explain the Manchester and B8ZS coding formats. 05
   d) It is desired to set up a central station for simultaneous monitoring of the Electrocardiograms (ECG) of 20 hospital patients. The data from the rooms of 20 patients are brought to a processing room over wires and are sampled, quantized, binary coded and time division multiplexed. The multiplexed signal are now transmitted to the monitoring station. The ECG signal bandwidth is 100 Hz. The maximum acceptable error in sample amplitude is 0.25% of the peak signal amplitude. The sampling rate must be at least twice the Nyquist rate. Determine the minimum cable bandwidth needed to transmit these data. 10

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Assume that a computer terminal has 110 characters (on its keyboard) and that each character is sent by using binary words. 06
   i) What are the number of bits needed to represent each character?
   ii) How fast can the characters be sent (characters/s) over a telephone line channel having a bandwidth of 3.2 kHz and an SNR of 20 dB?
   b) Describe the PLL based FSK demodulation. Show that the minimum shift keying (MSK) is a special form of binary CPFSK, where the phase transition for each bit change is $\pi/2$ radians. 06+07
   c) Draw the block diagram of offset QPSK (OQPSK) and hence explain the bandwidth considerations of it. 03+03
   d) For a BPSK modulator with a carrier frequency of 70 MHz and an input bit rate of 10 Mbps, determine the maximum and minimum upper and lower side frequencies, the minimum Nyquist bandwidth and the baud rate. Also draw its output spectrum. 10

6. a) Draw the block diagram of FFT based orthogonal frequency division multiplexing (OFDM) system model. How inter carrier interference and inter symbol interference are reduced in OFDM scheme? 05+06
   b) Suppose, the input bit sequence: 110011001010, i) draw the I bit, Q bit, and C bit, ii) determine the output phase sequence of the reference carrier $sin\omega_c t$, iii) determine the number of symbols, and iv) draw the corresponding constellation diagram. Consider the modulation scheme as 8-PSK. 09
   c) For a quadbit input of I = 1, I′ = 1, Q = 1, and Q′ = 0, determine the output amplitude and phase for the 16-QAM modulator considering the reference carrier as $sin\omega_c t$. 06
   d) Find the 3 dB bandwidth for a Gaussian low pass filter used to produce 0.25 GMSK with a channel data rate of R_b = 270 kbps. What is the 90% power bandwidth in the RF channel? Specify the Gaussian filter parameter α. 09

7. a) What is spread spectrum system? Briefly describe its frequency hopping type using transmitter and receiver block diagrams. 12
   b) What can be gained from the apparent waste of spectrum in spread spectrum system? 05
   c) What is matched filter detection? For an optimum receiver, prove that the maximization of output signal to noise ratio requires a filter with an impulse response which is time reversed and delayed version of the input signal. 02+07
   d) Discuss the coherent and non-coherent detection techniques. For the coherent detection of binary Frequency Shift Keying (FSK), prove that the probability of bit error is given by $P_b = Q(\sqrt{1.217E_b/N})$. 04+05

8. a) Define: i) peak to average power ratio (PAPR), and ii) orthogonality of carrier. Discuss the effect of transmission channel on OFDM. 03+03 +04
   b) Consider the input data: 10110, and the pseudo noise bit stream: 011010001101110. Now, draw the direct sequence spread spectrum signal using BPSK. 07
   c) Explain the binary threshold detection technique for reducing probability of error in Gaussian channel noise. 10
   d) Define bandwidth efficiency mentioning its physical significance. Determine the bandwidth efficiency for the following modulators: i) QPSK, f_b = 15 Mbps, ii) 8-PSK, f_b = 26 Mbps, iii) 16-QAM, f_b = 25 Mbps, iv) 16-PSK, f_b = 60 Mbps. 08

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 3rd year 2nd Term Examination, 2016

Department of Electronics & Communication Engineering

ECE-3207

(Antenna Engineering)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is antenna? Describe the mechanism of radiation by an antenna mentioning the necessary conditions. 12

b) The normalized radiation intensity of an antenna is represented by $U(\theta) = \cos^2(\theta)\cos^2(3\theta)$, $0 \le \theta \le 90^\circ$. Find 08
i) half power beamwidth (in radians and degrees),
ii) first null beamwidth (in radians and degrees).

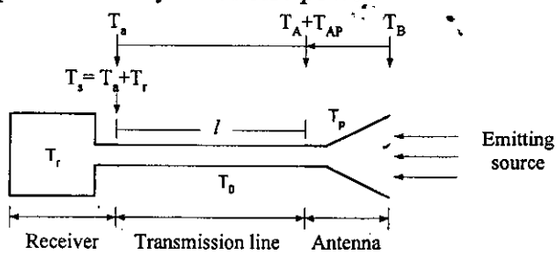
c) Define the followings in the context of antenna engineering: 09
i) Omnidirectional pattern, ii) Radiation efficiency, and iii) Absolute gain.

d) A uniform plane wave is incident upon a very short lossless dipole ($l << \lambda$). Find the maximum effective area assuming that the radiation resistance of the dipole is $R_r = 80(\pi l/\lambda)^2$, and the incident field is linearly polarized along the axis of the dipole. 06

2. a) "If the losses are zero, then half of the captured power by an antenna is delivered to the load and the other half is scattered" – justify the statement. 12

b) What is maximum effective aperture and aperture efficiency of an antenna? 06

c) From the figure below, find the noise temperature components at each interface and hence give the expression for system noise power. 09



d) A resonant half wavelength dipole is made out of copper ($\sigma = 5.7\times10^7$ S/m) wire. Determine the conduction-dielectric efficiency of the dipole antenna at $f = 300$ MHz if the radius of the wire b is $3\times10^{-4}\lambda$ and the radiation resistance of the $\lambda/2$ dipole is 73 Ohms. 08

3. a) State and explain reciprocity theorem in case of electromagnetic theory. 09

b) What is meant by radiation lobe? Describe HPBW and FNBW using radiation lobe. 07

c) Outline the characteristics of infinitesimal dipole antenna? For this type of antenna, show that i) radial electric energy is greater than radial magnetic energy, zsii) conditions for the reactive power diminishes. 08

d) Prove that the total radiation resistance of an infinitesimal dipole is $R_r = 80\pi^2(l/\lambda)^2$, where the symbols have their usual meanings. 11

4. a) Derive the expression of total E and H field of finite length dipole. Also find the value of radiation intensity of it. 15

b) For a multiturn loop antenna, show that $R_r = 31{,}171N^2(S^2/\lambda^4)$, where the symbols have their usual meanings. 10

c) The radius of a small loop of constant current is $\lambda/25$. Find the physical area of the loop and compare it with its maximum effective aperture. Also draw the equivalent circuit of a loop antenna in transmitting mode. 10

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What is antenna array and uniform linear array? 03+03

b) Find out the value of electric field with linear-'n' isotropic point sources. 10

c) Mention the significance of tapering of antenna array. Also describe the tapering method of Binomial array. 03+10

d) Draw the radiation pattern of 8-isotropic point sources, feed in phase and spaced $\lambda/2$, using pattern multiplication. 06

6. a) How can we increase the power gain and the directivity of V-antenna? 08

b) How unidirectional radiation pattern is converted to bidirectional radiation pattern of Rhombic antenna? 07

c) What do you mean by Beam antenna? Find out the value of input impedance of driver and parasitic elements of Yagi-Uda antenna. 04+10

d) Write down the advantages of folded dipole antenna. 06

7. a) What are the limitations of microstrip antenna? How can you overcome the limitations? Mention some advantages of this antenna. 03+04+02

b) "Helical antenna, sometime acts as a loop antenna and a small dipole antenna" – justify the statement. 08

c) Describe the Babinet's principle. 06

d) For end fire array consisting of several half wave length long isotropic radiator is to have a directive gain of 30. Find the array length and width of the major lobe (i.e., beam-width between first nulls). What will be these values for a broadside array? 06+06

8. a) Find out the spacing factor τ and apex angle α for the log periodic antenna. 08

b) What is spillover? Describe cassegrain antenna system and write down its merits and demerits. 02+03+04

c) Show that the radius of E-plane type of metal antenna $r = \dfrac{L(1-\mu)}{1-\mu\cos\theta}$, where the symbols have their usual meanings. 10

d) A parabolic antenna having a circular mouth is to have a power gain of 1000 at $\lambda = 10$ cm. Estimate the diameter of the mouth and the half power beamwidth of the antenna. 08

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 3rd Year 2nd Term Examination, 2016

Department of Electronics and Communication Engineering

CSE 3209

(Database System)

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define the following terms: (08)
(i) Entity set, (ii) Domain, (iii) Relationship set, and (iv) Composite attribute
b) What do you mean by "Participation of an entity set in a relationship set"? Define total and partial participation with example. (07)
c) What are cardinality constraints? Explain with example. (07)
d) Differentiate between strong and weak entity sets. (06)
e) Consider the following car insurance tables: (07)
Person (driver-id, name, address),
Car (license, year, model),
Accident (report-number, date, location),
Participated (driver-id, license, report-number, damage-amount).
Identify the primary/foreign keys and construct an E-R diagram for a car-insurance company from the above tables whose customers own one or more cars each. Each car has associated with it zero to any number of recorded accidents.

2. a) Explain existence dependency with example. (05)
b) What is UML class diagram? Draw an example diagram. (05)
c) Use Armstrong's axioms to prove the soundness of the union rule. Union rule: if $\alpha \rightarrow \beta$ and $\alpha \rightarrow \gamma$ then $\alpha \rightarrow \beta\gamma$. (06)
d) Write the algorithm to compute α^+, the closure of α under F: $\alpha \rightarrow \beta$ is in $F^+ \leftrightarrow \beta \subseteq \alpha^+$. (09)
Suppose R = (A, B, C, G, H, I) and F = {A→ B, A→ C, CG → H, CG → I, B → H}. Compute $(AG)^+$ and $(AB)^+$. Which one is the candidate key and why.
e) Differentiate between super key and candidate key. Compute the closure of the following set F of functional dependencies for relation schema: (10)

$$R = (A, B, C, D, E)$$
$$F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$$

List the candidate keys for R.

3. a) What is canonical cover? Write an algorithm to compute canonical cover. Suppose, R = (A, B, C), F= {A → BC, B → C, A → B, AB → C}. Find the canonical cover for F. (10)
b) What is Boyce-Codd Normal Form (BCNF)? Write the BCNF decomposition algorithm. Suppose, (14)
R=(branch-name, branch-city, assets, customer-name, loan-number, amount)
F={branch-name → assets branch-city
loan-number → amount branch-name}
Key={loan-number, customer-name}
Decompose the relation scheme R using BCNF decomposition algorithm.
c) "It is not always possible to get a BCNF decomposition that is dependency preserving" – explain this statement with appropriate example. (06)
d) What do you mean by third normal form? (05)

4. a) Write the 3NF decomposition algorithm. What are the differences between 3NF and BCNF? (08)
b) Show the comparison between sparse index and dense index with example (09)

c) What is B^+ tree? Compare balanced binary tree with B^+ tree. (06)

d) Construct a B^+ tree for the following data: (1, 4, 7, 10, 17, 21, 31, 25, 19, 20, 28, 42) with $n = 4$. Show each step for the tree construction. (12)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Differentiate DBMS and database system. Discuss the purpose of database system. (09)

b) How does query processor process a query? Explain briefly. (12)

c) What do you mean by data model? Discuss the basic structure of a relational model with example. (07)

d) Discuss the tradeoff between a sub query operation and a join operation. (07)

6. a) Write the components of storage manager and explain shortly about them. (08)

b) Write down the significance of primary key, unique key and foreign key. (07)

c) Let the following relational schema be given: R = (A, B, C); S = (D, E, F), let relations r(R) and s(S) be given. Give a SQL statements that are equivalent to the following relational algebra. Expressions: (12)

(i) $\pi_{AB}(r) \bowtie \pi_{BC}(r)$, (ii) $\pi_{A,F}(\sigma_{c=D}(r \times s))$, and (iii) $\rho_T(\sigma_{A=D}(r \times s))$

d) What do you mean by view? What are the advantages of view? (08)

7. a) Why do we need PL/SQL? Consider the table mentioned in Table-7(a). Now write the following queries: (09)

(i) A PL/SQL block to calculate the grades of the students.

(ii) Show the number of students that have enrolled in subject S1, S2 and S3, respectively.

Table: 7(a)

Roll	Subject	Marks
01	S1	80
02	S2	75
03	S1	67
04	S2	85
05	S3	77

b) "Every cascadeless schedule is also recoverable" – justify the statement with example. (09)

c) Define deadlock situation in database with example. (08)

d) What is cascading roll-back? How does two-phase locking protocol avoid cascading roll-back? (09)

8. a) What is concurrency control? State the name of various ways to achieve concurrency control. (07)

b) Briefly explain multiple granularities locking scheme. (10)

c) What do you mean by transaction? Explain with example. (07)

d) Define conflict serializability. Consider the precedence graph of Fig. 8(d). Is the corresponding schedule conflict serializable? Explain your answer. (11)

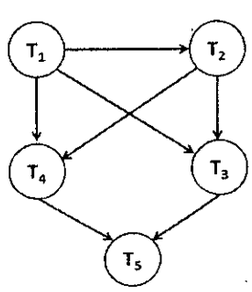


Fig. 8(d)