

BCSE 2nd Year 2nd Semester Examination, 2022
Advanced Object Oriented Programming

Full marks: 100

Time: 3 hours

Use separate answer script for each part**Part A (answer w.r.t. JAVA) -- 50 Marks****CO1 Conceptualize the object oriented features [20 Marks]**

- 1. a) Java is platform independent -- Explain. 2
- b) Mention few basic features in Java language which make it robust and secured. 2
- c) Compare function overloading and function overriding in Java. 3
- d) Discuss the role of access specifiers for the members of a class. 3
- e) Credential of an applicant consists of academic and skill credential. Academic credential is described by highest academic degree, year of completion, institute awarding the degree and score (if applicable). Skill credential consists of programming languages known, software tools known. Certain operations exist in to access and set the value for academic and skill credential. Academic and skill credentials are always required only as part of credential. Design the necessary class(es). 3
- f) In a two dimensional array of integers number of columns may vary across the rows. Write down the code snippet to implement the array and to show the number of columns in each row. 3
- g) Compare abstract class and interface. 2
- h) Ordering of exception handlers is important -- Explain 2

CO2 Understand and Develop concurrent programming [10 Marks] [Answer either Q.2 or 3]

- 2. a) Why is it important to control the concurrency in multithreaded programming? Explain with an example how it can be done? Provide skeleton code. 3+3
- b) Comment on the usage and purpose of wait() and notify(). 4
or
- 3. a) Consider Account contains account number and balance. In a multithreaded programming environment one may like to know the balance of an account (query), deposit or withdraw certain amount. Query is always allowed. With an account only one transaction (withdraw/deposit) can be

carried out at a time. Furthermore, at the time of withdraw if the withdrawal amount is less than the balance then it must wait till money is deposited.
Provide the skeleton code for the scenario.

8

b) Compare start() and run().

2

CO3 Understand and Develop event driven programming [10 Marks] [Answer either Q.4 or 5]

4. a) Assume, an array contains student objects. Student object contains roll, name and scores in five subjects. Provide the skeleton of student class. Now write GUI application/applet that accepts a roll and if 'search' button is clicked it displays the total score for the student. If roll is not found then displays suitable message. Program stops if 'exit' button is clicked.

10

or

5. a) Write the code snippet to display number of options to the user. User may select one or more options. Once 'done' button is clicked it will show the selected options.

7

b) What is layout manager? What are the default layouts for frame and panel?

3

CO4 Design and implement object oriented solution for problems [10 Marks] [Answer either Q.6 or 7]

6. a) Assume a binary file is there that has stored the marks (integers) for all the students. Write the code to find the highest score.

4

b) What is a collection framework?

2

c) Design a class MyClass so that for the collection of MyClass objects standard contains() method can be applied.

4

or

7. a) Each student has roll, name and score. Consider a collection of students. Take the measures and write the relevant code so that standard sort() algorithm can be used to sort the collection in the descending order of score.

7

b) What is the specialty and purpose of Serializable interface?

3

Part B (answer w.r.t. Python) -- 50 Marks

Answer any 5 questions. 5 X 10 = 50

1. Discuss advantages of Python over Java as an Object Oriented Programming Language. 10 [CO1]
2. Why Python is called as dynamic and strongly typed language? Discuss the `ord()`, `hex()`, `oct()`, `complex()` and `float()` type conversion functions with examples. 5+5=10 [CO1]
3. Search for palindrome and unique words in a text using class method and string method. 5+5=10 [CO4]
4. Create a GUI application in Python that provides an Entry field where the user can provide the name of a text file. Open the file and read it, displaying its contents in a Label. You can also replace the Entry widget with menu that has a File Open option that pops up a window to allow the user to specify the file to read. Also add an Exit or Quit option to the menu rather than having a QUIT button. 10 [CO3]
5. Write a Python program to design a simple connection-oriented server, explaining the connection-oriented service. 10 [CO2]
6. Discuss the following list functions - a) `len()` b) `sum()` c) `any()` d) `all()` e) `sorted()`. Write first seven Fibonacci numbers using generator next function/ yield in python. Trace and memorize the function. 5+5=10 [CO1]
7. Create a list of Tuples. Each Tuple should contain an item and its price in float. Write a program to sort the tuples in descending order by price. Use `operator.itemgetter()`. Write a program that proves that the dictionary returned by `globals()` can be used to manipulate values of variables in it. 5+5=10 [CO2]
8. Explain different Functional programming features in Python. Write a program that implements a stack data structure of specific size. If the stack is full and we are trying to push an item, then an `IndexError` exception should be raised. Similarly, if the stack is empty, then an `IndexError` exception should be raised. 5+5=10 [CO3]

Bachelors of Computer Science and Engineering 2022

(2nd Year, 2nd Semester)

Mathematics IV

Full Marks: 100 /

USE SEPARATE ANSWER SCRIPTS FOR GROUP A AND GROUP B

Group A

FULL MARKS: 50

Answer question 1 any SIX from the rest:

1. Define a limit point of a nonempty subset of the set of real numbers, \mathbb{R} . Find the limit points of the open interval $(0, 1)$ in \mathbb{R} . 2
2. Let A, B, C be three subsets of a set X . Prove or disprove the following: 8

$$(i) A \cap (B \Delta C) = (A \cap B) \Delta (A \cap C). \quad (ii) A \times (B \Delta C) = (A \times B) \Delta (A \times C)$$

3. Define an equivalence relation on a nonempty set. Let $S = \mathbb{Z} \times \mathbb{Z}$, where \mathbb{Z} is the set of integers. Let ρ be a binary relation on S defined by

$$(a, b)\rho(c, d) \text{ if and only if } a + d = b + c.$$

Determine whether ρ is an equivalence relation on S or not. 8

4. Define cardinal numbers of a set. Let α, β, γ be three cardinal numbers. Prove that $(\alpha^\beta)^\gamma = \alpha^{\beta\gamma}$. 8
5. Define a countable set. Prove that the set of rational numbers is countable. 8
6. What is the least upper bound property. Show that the set of rational numbers does not have the least upper bound property. 8

[2]

✓ 7. What is a tautology? Prove that $p \vee \neg(p \wedge q)$ is tautology.

8

8. Define injective, surjective and bijective functions. Let $f : A \rightarrow B$ and $g : B \rightarrow C$ be two functions, where A, B, C be three nonempty sets. If $g \circ f$ is bijective, then prove that f is injective and g is surjective.

8

9. Use mathematical induction to prove the following

$$1 \cdot 2 + 2 \cdot 3 + 3 \cdot 4 + \dots + n \cdot (n+1) = \frac{n(n+1)(n+2)}{3},$$

for any positive integer n .

8

**Bachelor Of Computer Science and Engineering
(2nd Year, 2nd Semester, 2022)**

Mathematics IV

(Algebra, Probability and Stochastic Processes)

Full Marks: 100

USE SEPARATE ANSWER SCRIPTS FOR GROUP A AND GROUP B

Symbols/notations used have their usual meaning

Group B

Probability and Stochastic Processes

FULL MARKS: 50

Answer question numbers 1 and 2 any THREE from the rest:

1. (i) State Markov's inequality.
 - (ii) State Bayes' theorem on conditional probability.
 - (iii) If A and B are two events such that $P(A) = P(B) = 1$, then show that $P(A + B) = 1, P(AB) = 1$.
 - (iv) A bag contains tickets numbered from 1 to 20. Two tickets are drawn. Find the probability that
 - (a) Both tickets have prime number on them.
 - (b) On one them is a prime number and on the other is a multiple of 4.
- 2+1+2+5**
2. (i) A point is chosen at random on a semi-circle having centre at the origin and radius unity and projected on the diameter. Prove that the distance of the point of projection from the centre has the probability density $\frac{1}{\pi\sqrt{1-x^2}}$ for $-1 < x < 1$ and zero elsewhere.

- ✓ (ii) A point X is chosen at random on a line segment AB whose middle point is O . Find the probability that AX , BX and AO form the sides of a triangle.

5 + 5

3. (i) Assuming that the lifespan of transistor is normal, find the mean and standard deviation if 84% of the transistors have lifespan less than 65.2 months and 68% have lifespan lying between 65.2 and 62.8 months. (Given that $\Phi(0.9) = 0.84$ and $\Phi(-0.9) = 0.16$)

- ✓ (ii) Derive the mean and standard deviation of a Binomial distribution with parameters n & p .

4. (i) The joint density function of X and Y is given by

$$f(x, y) = \begin{cases} 2e^{-x}e^{-2y} & 0 < x < \infty, 0 < y < \infty \\ 0 & \text{otherwise} \end{cases}$$

compute:

(a) $P(X > 1, Y < 1)$

(b) $P(X < Y)$

(c) $P(X < a)$

- (ii) The joint density of X and Y is given by

$$f(x, y) = \begin{cases} \frac{12}{5}x(2-x-y) & 0 < x < 1, 0 < y < 1 \\ 0 & \text{otherwise} \end{cases}$$

Compute the conditional density of X given that $Y = y$, where $0 < y < 1$.

- (iii) Suppose that the joint density of X and Y given by,

$$f(x, y) = \begin{cases} \frac{e^{\frac{x}{y}} e^{-y}}{y} & 0 < x < \infty, 0 < y < \infty \\ 0 & \text{otherwise} \end{cases}$$

Find $P(X > 1 | Y = y)$

4+4+2

- ✓ 5. (i) Let X_n , $n \geq 0$, be a Markov chain whose state space S is a subset of $\{0, 1, 2, \dots\}$ and whose transition function P is such that

[5]

$$\sum_y yP(x, y) = Ax + B, x \in S,$$

for some constants A and B .

(a) Show that $EX_n + 1 = AEX_n + B$. ✓

(b) Show that if $A \neq 1$, then

$$EX_n = \frac{B}{1-A} + A^n(EX_0 - \frac{B}{1-A}).$$

(iii) State and prove Chapman-Kolmogorov equation

5+5

6. The men's department of a large store employs one tailor for customer fittings. The number of customers requiring fittings appears to follow a Poisson distribution with mean arrival rate of 24 per hour. Customers are fitted in a first come first serve basis. The time it takes to fit a customer appears to be exponentially distributed with mean 2 minutes. (a) What is the average number of customers in the fitting room? (b) How much time should customer expect to spend in the fitting room? (c) What is the percentage of the time when tailor is idle? (d) What is the probability that a customer have to wait for more than 10 minutes for tailor's service?

10

Bachelor in Computer Science and Engineering
2nd Year, 2nd Semester Exam 2022
Graph Theory and Combinatorics

Full Marks : 100

Time : 3 Hrs

Write answers to the point. Make and state all the assumptions (wherever made).
ALL PARTS OF A QUESTION SHOULD BE ANSWERED TOGETHER

Section A Answer all questions $[10 \times 2.5 = 25]$

(1) Which of the following sequences can not be the degree sequence of any graph? Give reasons

- (A) $\begin{smallmatrix} 1 & 2 & 3 & 1 & 5 & 6 & 7 & 8 \\ 7 & 6 & 5 & 4 & 4 & 3 & 2 & 1 \end{smallmatrix}$
- (B) $\begin{smallmatrix} 6 & 6 & 6 & 6 & 3 & 3 & 2 & 2 \end{smallmatrix}$
- (C) $\begin{smallmatrix} 7 & 6 & 6 & 4 & 4 & 3 & 2 & 2 \end{smallmatrix}$
- (D) $\begin{smallmatrix} 8 & 7 & 7 & 6 & 4 & 2 & 1 & 1 \end{smallmatrix}$

(2) Prove that in finite graph, the number of vertices of odd degree is always even.

(3) Let G be a simple connected planar graph with 13 vertices and 19 edges. State the number of faces of the graph

(4) Construct a 8-vertex tree whose Prüfer code is: (1, 8, 1, 5, 2, 5).

(5) How many edges can there be in a forest with p components having n vertices in all?

(6) Let $G(x) = \frac{1}{(1-x)^2} = \sum_{i=0}^{\infty} g(i)x^i$, where $|x| < 1$. What is $g(i)$?

(7) n couples are invited to a party with the condition that every husband should be accompanied by his wife. However, a wife need not be accompanied by her husband. What are the number of different gatherings possible at the party?

(8) How many different strings can be made by reordering the letters of the word "S U C C E S S"?

(9) What is the solution of the recurrence relation $a_n = a_{n-1} + 2a_{n-2}$ with $a_0 = 2$ and $a_1 = 7$?

(10) What is the generating function for the sequence 1, 1, 1, 1, 1, 1?

Section B Answer any Five(5) Questions. You can keep your answer in the "Combinatorial Form"
 $[5 \times 6 = 30]$

(1) We have Rs n . Every day we buy exactly one of the following products: candy (Rs 1), chocolate (Rs 2), ice-cream (Rs 2). What is the number M_n of possible ways of spending all the money?

(2) Prove by Induction that every third element in a Fibonacci sequence is an even number.

(3) Show that the minimum number of ordered pairs of non-negative numbers that should be chosen to ensure that there are two pairs (a, b) and (c, d) in the chosen set such that, $a \equiv c \pmod{3}$ and $b \equiv d \pmod{5}$ is 16.

(4) What is the closed form expression for the generating function of the sequence $\{a_n\}$, where $a_n = 2n + 3$ for all $n = 0, 1, 2, \dots$?

(5) In how many ways can a given positive integer $n \geq 2$ be expressed as the sum of 2 positive integers (which are not necessarily distinct). For example, for $n = 3$, the number of ways is 2, i.e., $1 + 2, 2 + 1$.

- (6) In how many ways can a given positive integer $n \geq 3$ be expressed as the sum of 3 positive integers (which are not necessarily distinct). For example, for $n = 4$, the number of ways is 3, i.e., $1 + 2 + 1$, $2 + 1 + 1$ and $1 + 1 + 2$.

Section C Answer any Five(5) Questions

[5 × 6 = 30]

- (1) Prove or disprove (i) K_3 is non-planar (ii) $K_{3,3}$ is planar.
- (2) A graph is d -regular if every vertex has degree d . For a d -regular graph on n vertices, show that at least one of d and n is even.
- (3) Prove that in a connected graph, any two longest paths have at least one vertex in common.
- (4) Prove or disprove: No digraph contains an odd number of vertices of odd outdegree or an odd number of vertices of odd indegree.
- (5) Let F and H be two disjoint connected non-Eulerian regular graphs and let $G = (F + H).K_1$; that is, G is obtained from F and H by adding a new vertex v and joining v to each vertex in F and H . Prove that G is Eulerian.
- (6) Show that the Petersen graph does not have a Hamilton circuit, but the subgraph obtained by deleting a vertex v has a Hamilton circuit.

Section D Answer any one question

[15]

- (1) In an undirected graph G with n vertices, vertex 1 has degree 1, while each vertex $2, \dots, n - 1$ has degree 10 and the degree of vertex n is unknown. Give reasons why the following statements are TRUE or FALSE
 - (a) There is a path from vertex 1 to vertex n :- TRUE
 - (b) There is a path from vertex 1 to each vertex $2, \dots, n - 1$:- FALSE
 - (c) Vertex n has degree 1 :- FALSE
 - (d) The diameter of the graph is at most $\frac{n}{10}$:- FALSE
- (2) Let v be a vertex in a connected graph $G(V, E)$. Prove that there exists a spanning tree $T(V, E')$ of $G(V, E)$ such that the distance of every vertex from v is the same in $G(V, E)$ and in $T(V, E')$

JADAVPUR UNIVERSITY

B. E. (C.S.E.) 2ND YEAR 2ND SEMESTER EXAMINATION 2022
MICROPROCESSOR AND ASSEMBLY LANGUAGE PROGRAMMING

Time: Three Hours

Full Marks: 100

*Different parts of the same question must be answered together*Answer questions Q1 and Q2:

1. a) What is addressing mode? Describe different addressing modes of 8085 μ P with examples. 2+10
 b) How many machine cycle and T states are required to execute MVI M, 05_H? Write the names of these machine cycles. Write the steps and draw the timing diagram of data flow to execute the instruction. Assume that the instruction is stored from 2050_H 3+4+6
2. (a) Interface 4K RAM chip as two memory chips (modules) of 2K (M1) and 2K (M2) beginning at address 2000_H using a suitable decoder. Explain its address decoding technique and find its RAM address range. Assume/generate appropriate signals and pins. 10+5
 b) What is partial decoding? Explain foldback memory using the data given in 2. (a). 5+5

Answer any two from the following questions Q3 – Q6:

3. a) What is an interrupt? What happens when microprocessor receives an interrupt? 5+5
 b) Name the different types of vectored and non-vectored interrupts? 5
 c) Describe a scheme with a schematic diagram to resolve multiple interrupts from two or more peripherals simultaneously through INTR line. 10
4. a) A set of N data bytes is stored in m/m locations starting from 2501_H. The value of N is stored in 2500_H. Write a program (with comments) to store these data bytes from m/m location 2600_H if either D₀ or D₇ is 1; otherwise reject the data byte. 13
 b) There are N bytes stored from m/m location 2500_H. The value of N is stored in 2400_H. Write a program (with comments) to find the sum of these bytes if D₄D₃ = 10. Store the result in locations 2300_H and 2301_H. 12
5. a) There are N data bytes stored from m/m location 2500_H. Write an 8085 program to copy the even and odd integers into the m/m locations starting from 5050_H and 6050_H, respectively. 13
 b) Write a delay program for 1.0 ms in a 2 MHz microcomputer system. 12
6. a) Describe the functions of BIU and EU of the 8086 μ P using their schematic diagrams. 10
 b) Describe how program execution speeds up in 8086 μ P? 5
 c) If the CS register contains 2050_H and IP register contains ABCD_H, what is the physical address of the instruction to be fetched? 5
 d) What are the advantages of segmentation based approach to m/m accessing in 8086 μ P. 5

B.E. COMPUTER SCIENCE & ENGINEERING 2nd YEAR 2nd SEMESTER EXAM- 2022

DATA COMMUNICATION

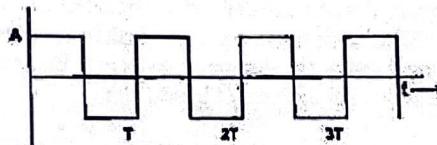
Time: 3 hours

Full Marks: 100

Group A (Total Marks: 20) [CO1]

Answer Question No. 1 (Compulsory) and Question No. 2 OR Question No. 3

1. What is the significance of the OSI model? What are the responsibilities of Physical Layer and Data link layer in Internet model? Discuss the advantages and disadvantages of combining the session, presentation and application layer in the OSI model into one single application layer in the Internet model. 2+4+4
2. Explain important criterions for an effective and efficient network? Assume hypothetically that we have two links of the same delay, say 2 sec. The bandwidth of these links are 5bps and 25bps respectively. Discuss the performance of these two links. Consider a square wave form as shown below. Decompose it into its harmonics and show the frequency domain representation. 2+4+4



3. Why two separate frequencies are used for uplink and downlink transmission in case of satellite communication? Assume that we have a digital signal of bit rate N. Discuss the approximation (rough and better) of this digital signal with an analog signal in a low-pass channel with limited bandwidth. What is the required bandwidth of a low pass channel if we need to send 500 kbps by using baseband transmission? 2+6+2

Group B (Total Marks: 10) [CO2]

Answer any one i.e., Question No. 4 OR Question No. 5

4. What are the factors responsible for attenuation in case of terrestrial microwave communication? What is intermodulation noise? 2+2+3+3

A 400-milliwatt signal goes through ten devices, each with a noise level of 12.65 microwatts on average. The signal contains frequencies of 1000 Hz, 2000 Hz, 3000 Hz, and 4000 Hz. Calculate the theoretical highest bit rate for the channel.

Suppose, the theoretical maximum bit rate becomes 12000 bps if the above-mentioned channel is noiseless. In this case, what is the number bits per signal level used to represent the data?

5. What is crosstalk? How is it minimized in case of twisted-pair of wire? 2+2+2+4
Distinguish between attenuation distortion and delay distortion.

Let us consider a scenario where a signal travels through four points namely P_1 , P_2 , P_3 , and P_4 . The signal passes the points in the following order: P_2 , P_1 , P_4 , and P_3 . From P_2 to P_3 there is a 1 dB gain of power. Suppose, both from P_2 to P_1 and P_4 to P_3 the signal's power is reduced to one half. The voltages at P_4 and P_2 are denoted as V_4 and V_2 respectively and it is given that the value of $V_2 = 50$ volt. Find the value of V_4 .

Group C (Total Marks: 30) [CO3]

Answer Question No. 6 (Compulsory) and Question No. 7 OR Question No. 8

6. Describe (i) Baseline Wandering (ii) DC components (iii) Self-Synchronization. Explain the Manchester and Differential Manchester schemes (with suitable diagram and example) and discuss how they overcome the problems associated with other polar schemes? Explain what price you have to pay for digitization in terms of bandwidth. 6+6+3
7. Show that the bandwidth with $d=0$ in multilevel FSK is $B=L \times S$. Assume that the available bandwidth is 100 kHz, which spans from 200 to 300 kHz. What should be the carrier frequency and the bit rate if data is modulated using FSK with $d = 1$? 5+4+6

"In synchronous TDM, the data rate of the link is n times faster, and the unit duration is n times shorter." - Explain it. Assume that there are four sources, each creating 250 characters per second. If the interleaved unit is a character and 1 synchronizing bit is added to each frame, find (i) the data rate of each source, (ii) the duration of each character in each source, (iii) the frame rate, (iv) the duration of each frame, (v) the number of bits in each frame, and (vi) the data rate of the link.

8. Why do we need encoding of data before sending over a medium? What is quantization error? How can it be reduced? What is the result of scrambling the sequence 11100000000000 using a) B8ZS b) HDB3 scrambling techniques? Assume that the last non-zero signal level has been positive. Explain in accordance with the rules of each scheme. 2+3+5+5

Group D (Total Marks: 10) [CO4]

Answer any one i.e., Question No. 9 OR Question No. 10

9. Which digital conversion technique is more susceptible to noise? Defend your answer. Define carrier signal and its role in analog transmission. Describe a digital multiplexing technique for combining several low-rate channels into one high-rate one (with suitable diagram). Four 1-kbps

connections are multiplexed together. A unit is 1 bit. Find (a) the duration of 1 bit before multiplexing, (b) the transmission rate of the link, (c) the duration of a time slot and (d) the duration of a frame.

10. Compare the bandwidth requirement of the three digital-to-analog modulation techniques. Define DSSS and explain how it achieves bandwidth spreading.

Group E (Total Marks: 10) [COS]

Answer any one i.e., Question No. 11 OR Question No. 12

11. Discuss the concept of redundancy in error detection and correction. 2+2+6
Differentiate linear block code and cyclic code.

Let us consider a CRC generator polynomial is given below:

$$x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^5 + x^4 + x$$

Answer the following questions.

- How many single-bit errors can be detected by this generator polynomial? Please justify your answer.
- How many out of 10^{12} burst errors of size 33 are left undetected. Provide the calculation.
- How many out of 10^{12} burst errors of size 56 are left undetected. Provide the calculation.
- Is it capable of detecting a burst error of size 17? Justify your response.

12. What are the conditions to guarantee i) the detection of at least k errors and ii) the correction of at least m errors in a block code? 4+6

Let us consider a sender has some data in hexadecimal as follows: 3BC6 A45C 0E6C E2BE. If it is required to calculate the checksum, then show the checksum calculation in the sender and receiver site (assume no error occurs during data transmission and consider that a 16-bit checksum is used).

Now, suppose an error has occurred during transmission, and consequently the 8th and 12th hexadecimal digits from the left are changed to 'E' and 'A' respectively. In this scenario, show the checksum at the receiver site.

Group F (Total Marks: 20) [CO6]

Answer Question No. 13 (Compulsory) and Question No. 14 OR Question No. 15

13. To improve the efficiency of transmission, multiple frames must be in transition while waiting for acknowledgement. Discuss the design (with suitable diagram, flowchart/algoriithm) of a protocol to achieve this goal in noisy channels. 5+5

Let us consider, Stop-and-Wait ARQ Protocol is used by a system. How long does it take to deliver 1 million bits of data if each packet contains 1000 bits of data and the distance between the sender and receiver is 5000 km and the propagation speed is 2×10^8 m? Ignore any delays in transmission, waiting, or processing. We make the assumption that no data or control frames have been lost or corrupted.

Suppose, in the above scenario, it is now decided to use Go-back-N ARQ Protocol instead of Stop-and-Wait. In this case, how long does it take to deliver 1 million bits of data? Consider the sender window size in Go-back-N is 7 and ignore the overhead due to the header and trailer.

Moreover, if it is decided to use Selective-Repeat ARQ Protocol (window size 4), how much extra time does it take to deliver 1 million bits of data compared to that of the Go-back-N ARQ Protocol.

14. What is piggybacking? Explain its advantages? There is no pipelining in Stop-and-Wait ARQ protocol. Discuss the design of a protocol which improves the efficiency of transmission by using pipelining. 2+2+6

15. Consider the use of 10 K-bit size frames on a 10 Mbps satellite channel with 270 ms delay. What is the link utilization for stop-and-wait ARQ technique assuming $P = 10^{-3}$? Go-back-N ARQ is very inefficient for a noisy link. Discuss the design of a protocol to address this issue. 4+6

**B.E. COMPUTER SCIENCE & ENGINEERING 2nd YEAR 2nd SEMESTER
SUPPLEMENTARY EXAM- 2022**

Time: 3 hours

DATA COMMUNICATION

Full Marks: 100

Group A (Total Marks: 20) [CO1]**Answer Question No. 1 (Compulsory) and Question No. 2 (A) OR Question No. 2 (B)**

1. Draw the TCP/IP protocol stack and discuss the functionalities of Physical Layer and Data Link Layer. What is the difference between a port address, a logical address and a physical address? 5+5
2. A) What are the advantages of multipoint connection over a point-to-point connection? Why is a single frequency sine wave not useful in data communications? Explain with an example. 5+5

OR

- B) Explain frequency, wavelength, amplitude and phase of a signal. Distinguish between baseband transmission and broadband transmission. 5+5

Group B (Total Marks: 10) [CO2]**Answer any one i.e., Question No. 3 OR Question No. 4**

3. How can a composite signal be decomposed into its individual frequencies? If a periodic signal is decomposed into five sine waves with frequencies of 200, 400, 600, 800 and 1000 Hz. What is the bandwidth? Draw the spectrum, assuming all components have a maximum amplitude of 10V. 2+3+5

OR

4. What are the different types of impairments usually occurring in communication? Explain them. Discuss two theoretical formulas in Nyquist bit rate and Shannon capacity to calculate the data rate. 4+6

Group C (Total Marks: 30) [CO3]**Answer Question No. 5 (Compulsory) and Question No. 6 (A) OR Question 6 (B)**

5. i) Distinguish between a signal element and a data element. Define block coding and discuss its purpose. 4+6
ii) Why is a low-pass channel needed in digital transmission? Explain the bandwidth requirement for binary FSK. Calculate the number of levels and frequencies, the baud rate, and the bandwidth when the carrier frequency is 10 MHz and you want to send 4 bits at a time at a bit rate of 4Mbps. 2+3+5
6. A) Why is digital-to-analog conversion required? Which of the digital-to-analog conversion techniques (ASK, FSK, PSK, QAM) is the most susceptible to noise? Justify your answer with a suitable example. Explain the basic model of PSK implementation. 2+3+5

OR

B) What is a carrier signal? Explain its role in analog transmission. Which of the analog-to-analog conversion techniques (AM, FM, PM) is the most susceptible to noise? Justify your answer with a suitable example. Find the bandwidth for the following situations if we need to modulate a 8-KHz voice signal: (a) AM (b) FM (set $\beta = 5$) (c) PM (set $\beta = 1$)

2+2+6

Group D (Total Marks: 20) [CO4]

Answer any one i.e., Question No. 7 OR Question No. 8

7. i) Define the spread spectrum and its goal. Describe the DSSS and how it achieves bandwidth spreading. 3+7
 ii) What are the main differences between FM and AM. Explain the basic model of Frequency hopping spread spectrum. 4+6

OR

8. i) Explain the main objectives of multiplexing. Distinguish between a link and a channel in multiplexing. Distinguish between multilevel TDM, multiple slot TDM and pulse-stuffed TDM with suitable schematic diagrams. 2+2+6
 ii) If your main goal is to improve bandwidth efficiency then which TDM scheme will you select- explain your answer with a suitable example. What are the main differences between TDM and FDM? Four channels, two with a bit rate of 300 kbps and two with a bit rate of 250 kbps are to be multiplexed using multiple slot TDM with no synchronization bits. Find out the size of a frame in bits, frame rate, duration of a frame and data rate. 2+2+6

Group D (Total Marks: 10) [CO5]

Answer any one i.e., Question No. 9 OR Question No. 10

9. What kind of error is undetectable by the checksum? Explain the error detection method of checksum for a list of five 4-bit numbers (7, 3, 8, 0, 9). 2+8

OR

10. How does a single bit error differ from a burst error? How to make Hamming code respond to a burst error? Discuss the concept of redundancy in error detection and correction. 2+4+4

Group E (Total Marks: 10) [CO6]

Answer any one i.e., Question No. 11 OR Question No. 12

11. Define framing and explain the reason for its need with an example. Explain the Go-Back-N ARQ protocol with an illustration of the mechanism. 3+7
OR
12. Explain the reason for moving from the Stop-and-Wait ARQ protocol to the Go-Back-N ARQ protocol. Explain the Selective-Repeat ARQ protocol with an illustration of the mechanism. 3+7

