



UNIVERSITY OF ENGINEERING & MANAGEMENT  
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2021

*End Semester*  
3<sup>rd</sup> semester



**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Hydrology and Water Resource Engineering**

**Paper Code: CE702**

**Full Marks: 70**

**Time: 3 hours**

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**Answer all the questions. Each question is of 7 marks.**

- 1. A.** What is a stage discharge curve? How is it affected by a changing stage of the river compared to a constant stage?

**OR**

- B.** Define unit hydrograph. What are the assumptions underlying the unit hydrograph theory. How do they limit the applicability of unit hydrograph?

- 2. A.** Explain in detail different types of tube well.

**OR**

- B.** Write a note on efficiency of a well.

- 3. A.** A 35g/l solution of a chemical tracer was discharged into a stream @0.015 l/s. At sufficiently far downstream observation point, the chemical was found to reach an equilibrium concentration of 5 parts per billion. Estimate the stream discharge. The background concentration of the tracer chemical in stream water may be taken as nil.

**OR**

- B.** How to estimate the missing precipitation record of any rain gauge station? Discuss various methods for it in brief.

- 4. A.** Explain step by step procedure you would adopt to prepare the depth-area duration curves for a particular storm for a basin having a number of rain-gauges, most of which are recording.

**OR**

- B.** Describe how unit hydrograph can be used to predict the runoff from a storm. What are the uses of unit hydrograph?

- 5. A.** The annual rainfalls at 7 rain gauge stations in a basin are 55, 92, 63, 42, 18, 85 and 65cm respectively. What is the percentage accuracy of the existing network in the estimation of average depth of rainfall over the basin? How many additional gauges are required, if it is desired to limit the error to only 10%.

**OR**

- B.** Explain hydrograph analysis? What do you mean by base flow?

6. A. Enumerate the different methods which are used for stream gauging. Discuss any one of these methods in details.

OR

- B. What is stream gauging? Discuss in detail the velocity area method that is used for stream gauging.

7. A. A 40cm diameter well penetrates 25m below the static water table. After 24 hours of pumping @ 6000 liters/minute, the water level in a test well at 90m is lowered by 0.53m, and in a well 30m away the drawdown is 1.1m.

- i) What is transmissibility of the aquifer?  
ii) Also determine the drawdown in the main well.

OR

- B. Write a note on cavity formation in open wells.

8. A. A 35cm well fully penetrate a confined aquifer 30m deep. After a long period of pumping at a rate of 1300 lpm, the drawdown in the well at 20 and 45m from the pumping well are found to be 2.2 and 1.8 m respectively. Determine transmissibility of the aquifer. What is the draw down?

OR

- B. Explain: i) a method for estimating the missing rainfall data at a station in a basin. ii) a method for testing the consistency of rainfall records at a station and necessary adjustment.

9. A. Define infiltration. Describe how infiltration capacity rate can be measured using double ring infiltrometer.

OR

- B. Describe how unit hydrograph can be used to predict the runoff from a storm. What are the uses of unit hydrograph?

10. A. Find out the velocities of the ground water flow with the following data, using Slichter and Hazen's constants as 400 and 800 respectively.

Viscosity coefficient of water at ground water temperature of  $10^{\circ}\text{C}$  = 1

Effective size of the particles in the aquifer = 0.1mm

Hydraulic gradient = 1 in 80

OR

- B. Write a brief note on strainer tube well.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Digital System Design**

**Paper Code: ESC301**

**Full Marks: 100**

**Time: 3 hours**

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**Answer all the questions. Each question is of 10 marks.**

1. A. Draw and explain a 3 to 8 line decoder using NOT and NAND gates only. Mention the advantages of Decoder over Demultiplexer gate.  
**OR**  
B. Define Multiplexer. Implement the expression using a multiplexer along with the truth table:  $f(A,B,C,D) = \Sigma M(1,4,5,6,7,8,9,11,12,13)$ .
2. A. Design a Binary to Gray code converter and convert the number 101110110 from binary to gray code.  
**OR**  
B. Draw the logic diagram of a 1 bit full Adder using only NAND gate and explain the truth table.
3. A. Explain the multiple toggle of a JK flip flop. How can this condition be avoided? With the help of a diagram, explain the working of a T and D flip flop.  
**OR**  
B. Design the following function using suitable MUX:  $F(A, B, C, D) = \sum (1,3, 4, 5, 11, 13, 14)$ .
4. A. Design a 2 bit ring counter and explain its operation. What is to be done to make it a Jonshon counter? Explain.  
**OR**  
B. Design a full subtractor using two half subtractors. What iste function of borrow in subtractor?
5. A. What is ripple counter ? Design a presettable 3-Bit up asynchronous counter using R S flip-flop.  
**OR**  
B. A binary ripple counter is required to count up to  $(256)_{10}$ . How many flip-flops are required? If the clock frequency is 8-192 MHz, what is the frequency at the output of the MSB?
6. A. Design and explain a XS-3 to BCD code converter and draw the logic diagram only using basic gates.  
**OR**  
B. Draw and explain the working principle of a 3 bit parallel adder. What is the advantage of carry look ahed adder? What are its disadvantages?
7. A. Implement with a proper explanation a Full Adder circuit using Mutiplexer along with the truth table.

- OR**
- B. Create a excitation table for converting a SR flip flop to a D flip flop. Show the diagram and explain its operation.
8. A. State and prove DeMorgan's theorem and expand the function  
$$(A' + B'C + D')' + (C + A'D)'$$
- OR**
- B. Design a 3 bit Universal shift register using flip flops and explain its operation using proper clock diagram.
9. A. Simplify  $F(A,B,C,D) = \Sigma (1,4,8,10,12,13,14) + \Phi (3,5,11)$
- OR**
- B. Design an 4 bit asynchronous up down counter and explain its operation using suitable excitation table.
10. A. Prove the following:  
A positive logic OR operation is equivalent to a negative logic AND operation and vice-versa.
- OR**
- B. Design a MOD 8 synchronous down counter.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Humanities - I (Constitution of India, Essence of India and Knowledge Trading)**

**Paper Code: HSMC301**

**Full Marks: 100**

**Time: 3 hours**

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**Answer all the questions. Each question is of 10 marks.**

- 1. A. India is a secular state. Explain.**

**OR**

- B. How can a judge in a High Court removed?**

- 2. A. Bring out the powers and responsibilities attached to the office of the Speaker of the Lok Sabha.**

**OR**

- B. Explain any 5 federal features of our constitution.**

- 3. A. Write a short note of "Public Interest Litigation".**

**OR**

- B. Explain in brief any 5 salient features of 73<sup>rd</sup> Amendment Act of 1992.**

- 4. A. Who is the present Attorney General of India? What are his duties and functions?**

**OR**

- B. Why Regulating Act 1773 has a great constitutional significance? What are the features of this act? What are the features of Charter Act of 1793?**

- 5. A. How is the Vice President of India elected in India? Explain the election process.**

**OR**

- B. What are the various writs available to the citizens of India? Explain them.**

- 6. A. What are the main sources of the Indian constitution? Explain them in brief.**

**OR**

- B. How can a person loose Indian Citizenship?**

- 7. A. Write a short note on "Lok Adalats".**

**OR**

- B. What are the various merits of the Parliamentary system of government?**

- 8. A. What are the 5 sources of income of the urban local bodies?**

**OR**

- B. What are the demerits of the Parliamentary system of government?**

- 9. A. What are the reasons behind India adopting the Parliamentary system of government?**

**OR**

- B. Write a short note on "Qualification, Oath and Salary of the Judge of Supreme Court".**

10. A. What are the grounds of disqualification of a Member of Parliament from either House?

OR

B. Explain in brief about the pardoning powers of the President.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Discrete Mathematics**

**Paper Code: PCCCS302**

**Full Marks: 100**

**Time: 3 hours**

**Answer all the questions. Each question is of 10 marks.**

1. A. i) Which of these sentences are propositions? What are the truth values of those that are propositions?
  - a) Boston is the capital of Massachusetts.
  - b) Miami is the capital of Florida.
  - c)  $2 + 3 = 5$ .
  - d)  $5 + 7 = 10$ .
  - e)  $x + 2 = 11$ .
  - f) Answer this question.
- ii) Write the following statements using quantifiers:(any two)
  - a) Not all animals are ferocious.
  - b) Aliens exist.
  - c) Only good scholars are researchers.
  - d) All cats are dogs.

**OR**

- B. i) Let p and q be the propositions “The election is decided” and “The votes have been counted,” respectively. Express each of these compound propositions as an English sentence:
    - a)  $\neg p$
    - b)  $p \vee q$
    - c)  $\neg p \wedge q$
  - ii) What are the contrapositive, the converse, and the inverse of the conditional statement “The home team wins whenever it is raining?”
  - iii) Discuss about the different types of Well-formed formula.
2. A. i) Let A, B, and C be sets. Show that
    - a)  $(A \cup B) \subseteq (A \cup B \cup C)$ .
    - b)  $(A \cap B \cap C) \subseteq (A \cap B)$ .
  - ii) Find the number of subsets and the number of proper subsets of the set {m, a, t, h, y}.

**OR**

- B. i) Let A, B, and C be sets. Show that
  - a)  $(A - C) \cap (C - B) = \emptyset$ .
  - b)  $(B - A) \cup (C - A) = (B \cup C) - A$ .
- ii) Find the number of subsets and the number of proper subsets of the set {d, i, s, c, r, e, t, e}.

3. A. How many relations are there on a set with  $n$  elements that are
- reflexive and symmetric?
  - neither reflexive nor irreflexive?
  - irreflexive & asymmetric.
  - antisymmetric & asymmetric. (use matrix to establish the count)

**OR**

- B. Determine whether the relation  $R$  on the set of all real numbers is reflexive, symmetric, antisymmetric, and/or transitive, where  $(x, y) \in R$  if and only if
- $x + y = 0$ .
  - $x = \pm y$ .
  - $x - y$  is a rational number.

4. A. i) Let  $f$  be the function from  $R$  to  $R$  with  $f(x) = x^2$ . Is  $f$  invertible?  
 ii) Let  $f$  be the function from  $N$  to  $N$  with  $f(x) = x^2$ . Is  $f$  invertible?

**OR**

- B. Determine whether each of these functions is a bijection from  $R$  to  $R$ .

- $f(x) = -3x + 4$
- $f(x) = -3x^2 + 7$
- $f(x) = (x + 1)/(x + 2)$
- $f(x) = x^5 + 1$
- Specify the relation between function & relation and prove that using specific example.

5. A. State true or false with proper justification:

- Every poset is a lattice.
- Every lattice is a poset.
- Join semi lattice and meet semi lattice forms a lattice
- Hasse diagram does not contain incomparable elements.
- Complemented lattice forms Boolean algebra.

**OR**

- B. Explain the following with proper example:

- Sublattice
- Boolean algebra in terms of lattice.
- Distributive lattice
- Complemented lattice.
- Total ordered set.

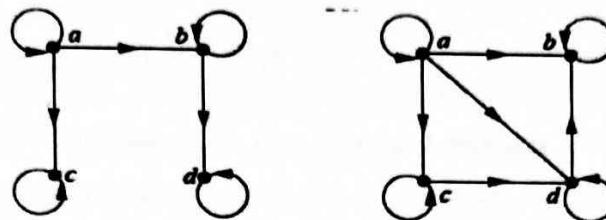
6. A. i) Determine whether the relations represented by these zero—one matrices are partial orders.

$$\text{a) } \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad \text{b) } \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

- ii) Compare and contrast the following  
 a) partial and total ordered set.  
 b) maximal and minimal element.

**OR**

- B. i) Determine whether the relation with the directed graph shown is a partial order:



- ii) Compare and contrast the following using appropriate example:  
 a) join and meet point.  
 b) chain and partial order.

7. A. Find the next larger permutation in lexicographic order after each of these permutation  
 i) 1432    ii) 54123    iii) 45231    iv) 6714235    v) 31528764  
 v) Specify the algorithm.

**OR**

- B. i) List all the three combination of {1,2,3,4,5}  
 ii) Find the next larger 4 combination of the set {1,2,3,4,5,6} after 1256.  
 iii) Mention the necessary algorithm.

8. A. i) State the rule of sum and product w.r.t counting.  
 ii) Each user on a computer has a password, which is eight to ten characters long where each character is an uppercase letter or a digit. Each password must contain at least one digit. How many possible passwords are there?

**OR**

- B. i) Identify the next 5 permutation of 1234 w.r.t the set {1,2,3,4,5,6}  
 ii) Generate the permutation of the integer 1,2,3 in lexicographic order.  
 iii) Mention the necessary algorithm.

9. A. i) Solve the following:  
 $a_n - 4a_{n-1} + 4a_{n-2} = 0$  where  $a_0 = 1$   $a_1 = 3$   
 ii) Specify the rules of solving linear non-homogeneous recurrence relation.

**OR**

- B. i) Find the recurrence relation, satisfying  $y_n = (A+Bn)4^n$   
 ii) Discuss about generating function and specify how it is used to in counting.

10. A. Solve these recurrence relations together with the initial conditions given.  
 $a_n = 6a_{n-1} - 8a_{n-2}$  for  $n \geq 2$ ,  $a_0 = 4$ ,  $a_1 = 10$

**OR**

- B. Solve these recurrence relations together with the initial conditions given.  
 $a_n = 2a_{n-1} - a_{n-2}$  for  $n \geq 2$ ,  $a_0 = 4$ ,  $a_1 = 1$

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Data Structure & Algorithm**

**Paper Code: PCCCS301**

**Full Marks: 100**

**Time: 3 hours**

**Answer all the questions. Each question is of 10 marks.**

1. A. Write different code fragments which can have following time complexities:  $O(n)$ ,  $O(n^2)$ ,  $O(\log n)$ ,  $O(\sqrt{n})$ ,  $O(\log \log n)$ . In each case derive the value.

**OR**

- B. Explain different asymptotic notations with proper diagram.
2. A. Explain memory allocation of a 3D array in row major and column major order with example.

**OR**

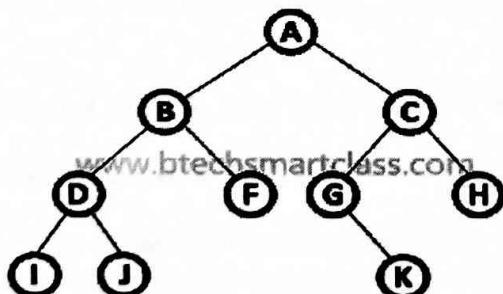
- B. Write an algorithm to implement sparse matrix using linked list.
3. A. Write an algorithm to check no. of parenthesis in a given expression using stack.

**OR**

- B. Solve the following expression using stack:  $14 / 6 * 5 - 34 + 7 * 5 + 23 - 5 / 4$ .
4. A. Write an algorithm to implement input restricted dequeue.

**OR**

- B. Explain the difference between a normal queue and priority queue operations with an example.
5. A. Please perform non-recursive in-order, pre-order & post-order traversal of the given tree.

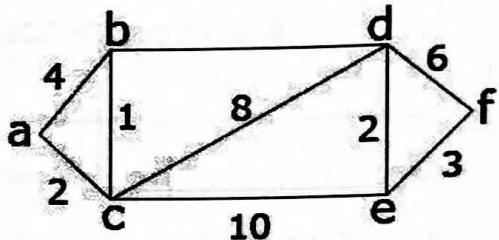


**OR**

- B. Write an algorithm to perform tree traversal in recursive way.
6. A. Construct a height balanced BST with the following data: 5, 4, 7, 8, 6, 12, 10, 9, 17, 15, 14.

**OR**

- B. Perform a heap sort (any order) for the following data: 5,6,3,6,1,8,9,3,5,4,7,8.
7. A. Compare the performance of quick sort by placing the pivot at left most position and middle position.  
**OR**  
 B. Compare the performance of linear search, binary search and interpolation search with a single dataset.
8. A. Compare BFS & DFS with a suitable example.  
**OR**  
 B. Find the shortest path between a & f.



9. A. Construct a B-tree of order 4 with the following numbers:  
 5,10,7,8,6,4,12,15,14,13,18,17,19,24,23,26,22,25.  
**OR**  
 B. Compare i) General Tree Vs Binary Tree ii) Binary Tree Vs m-array Tree.
10. A. Explain open addressing scheme with an example.  
**OR**  
 B. Suppose you are given the following set of keys to insert into a hash table that holds exactly 11 values: 113 , 117 , 97 , 100 , 114 , 108 , 116 , 105 , 99 . Insert all the values using linear probing.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Computer Organization & Architecture**

**Paper Code: ESC302**

**Full Marks: 100**

**Time: 3 hours**

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**Answer all the questions. Each question is of 10 marks.**

1. A. Using Booth's multiplication algorithm, multiply two numbers  $M = -5$  and  $Q = -7$   
**OR**  
B. What is Cache memory? Explain different types of mappings from main memory to cache memory.
2. A. Describe the operation of register direct and register indirect addressing mode with example.  
**OR**  
B. Describe the operation of Carry Propagation Adder with suitable diagram.
3. A. Describe the IEEE single precision and double precision format with proper example.  
**OR**  
B. Write Short notes on the following i) I/O Processor ii) Daisy Chain priority interrupt
4. A. Draw the circuit of a BCD adder / subtractor and explain its operations.  
**OR**  
B. Explain the operation of DMA controller with a neat diagram.
5. A. What are the advantages and disadvantages of VLIW architecture?  
**OR**  
B. Discuss SISD and MIMD models of parallel computers.
6. A. Evaluate the statement  $X = (A+B)-(C+D)$  in zero, one, two and three address instructions.  
**OR**  
B. Design a digital circuit that performs the 4 logic operations of EX-OR, Ex-NOR, NOR and NAND.
7. A. Explain RAW, WAR, WAW hazards in pipeline.  
**OR**  
B. State Amdahl's Law. What are the benefits of Amdahl's Law?
8. A. Explain static and dynamic pipeline with a proper diagram. What are the differences between them?  
**OR**  
B. Distinguish between synchronous data transfer and asynchronous data transfer.
9. A. What is branch hazard? Discuss briefly two approaches to handle branch hazards.  
**OR**  
B. What do you mean by hardware level and software level instruction parallelism?

10. A. Explain with the help of a diagram programmed I/O technique and interrupt I/O technique.

OR

- B. Consider a processor with 64 registers and an instruction set of size twelve. Each instruction has five distinct fields, namely, opcode, two source register identifiers, one destination register identifier, and a twelve-bit immediate value. Each instruction must be stored in memory in a byte-aligned fashion. If a program has 100 instructions, Calculate the amount of memory (in bytes) consumed by the program text.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE/CSIT/CST) Semester: 3<sup>rd</sup>**

**Paper Name: Mathematics & Statistics - III**

**Paper Code: BSC301**

**Full Marks: 100**

**Time: 3 hours**

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**Answer all the questions. Each question is of 10 marks.**

1. A. Show that the probability of occurrence of only one of the events A and B is  $P(A) + P(B) - 2P(AB)$ .  
**OR**  
B. In a factory machines A and B are producing springs of the same type. Of this production, machines A and B produce 5% and 10% defective springs, respectively. Machines A and B produce 40% and 60% of the total output of the factory. One spring is selected at random and it is found to be defective. What is the probability that this defective spring was produced by machine A?  
2. A. Urn I has 3 white and 4 black balls, Urn II has 5 white and 2 black balls, Urn III has 3 white and 5 black balls. An Urn is selected at random and a ball drawn at random is found to be black. Find the probability that Urn I was selected.  
**OR**  
B. A factory has two machines. The empirical evidence has established that machines I and II produce 40% and 60% of the output respectively. It has also been established that 3% and 2% of the output produced by these machines respectively was defective. A defective item is drawn at random. What is the probability that the defective item was produced by machine I or II.  
3. A. Show that the function  $f(x) = \frac{x^n e^{-x}}{n!}$ ,  $x > 0$  where n is a positive integer, is a pdf. Compute mean and variance?  
**OR**  
B. A random variable X has the following probability distribution:

$x$	0	1	2	3	4	5	6
$P(X = x)$	k	3k	5k	7k	9k	11k	13k

i) Find the value of k.  
ii) Find  $P(X < 4)$ ,  $P(X \leq 5)$ ,  $P(3 < X \leq 5)$ .  
iii) Obtain the distribution function  $F(x)$ .
4. A. If the weekly wage of 10,000 workers in a factory follows normal distribution with mean and s.d Rs. 70 and Rs 5 respectively, find the expected number of workers whose weekly wages are (i) between Rs. 66 and 72 (ii) less than Rs. 66 (iii) more than Rs. 72  
[Given that  $\frac{1}{\sqrt{2\pi}} \int_0^z e^{-\frac{t^2}{2}} dt = 0.1554$  and  $0.2881$  according as  $= 0.4$  and  $z = 0.8$  ]  
**OR**

- B. The probability that a pen manufactured by a company will be defective is  $\frac{1}{10}$ . If 10 such pens are manufactured find the probability that i) exactly three will be defective ii) none will be defective iii) at least one will be defective.
5. A. Define a Harmonic Function. Show that  $u = \frac{\log(x^2+y^2)}{2}$  is harmonic. Determine its harmonic conjugate and hence find the corresponding analytic function  $f(z)$  in terms of  $z$ .
- OR
- B. Determine the analytic function  $f(z) = u(x, y) + iv(x, y)$  where imaginary part  $v(x, y) = e^x \sin y$ .
6. A. Evaluate  $\oint \frac{\sin z}{z(z^2+4)} dz$  where the contour given is the boundary of the square whose sides are the straight lines  $x = \pm 2.5$ ,  $y = \pm 2.5$ .
- OR
- B. Expand the function  $f(z) = \frac{1}{(z-1)(z-2)}$  between the annular region  $|z| = 1$  and  $|z| = 2$ .
7. A. Evaluate  $\int (x - iy) dz$  from  $z = 0$  to  $z = 4 + 2i$  along the curve  $C$  given by  
 i) the straight line joining  $z = 0$  and  $z = 4 + 2i$ .  
 ii) the straight line from  $z = 0$  to  $z = 2i$  and the straight line from  $z = 2i$  to  $z = 4 + 2i$ .
- OR
- B. Evaluate  $\oint \frac{e^z}{(z+1)(z+2)} dz$  over the region  $|z - 1| = 4$ .
8. A. Evaluate:  $\int_0^1 dx \int_0^x \frac{y}{\sqrt{x^2+y^2}} dy$ .
- OR
- B. For the given function determine the poles and the residues at the poles:  $f(z) = \cot z$ .
9. A. Evaluate  $\int_0^{2\pi} \frac{d\theta}{1+b^2-2b \cos \theta}$ ,  $0 < b < 1$ . Take a complex number  $z$  of modulus 1 and amp  $\theta$ .
- OR
- B. Evaluate the following double integral :
- $$\int_0^1 \int_y^{\sqrt{y}} dx dy.$$
10. A. i) If  $X$  is uniformly distributed in  $[-\alpha, \alpha]$  with  $\alpha > 0$ , then determine  $\alpha$  such that  $P(X > 1) = \frac{1}{3}$ .  
 ii) There are 500 misprints in a book of 500 pages. What is the probability of the given page will contain at most 3 misprints
- OR
- B. The probability density function of a random variable  $X$  is  $f(x) = k(x-1)(x-2)$  for  $1 \leq x \leq 2$ . Determine (i) the constant  $k$ ? (ii) the distribution function  $F(x)$ ? (iii)  $P(\frac{5}{4} \leq x \leq \frac{3}{2})$ ?

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CS) Semester: 3<sup>rd</sup>**

**Paper Name: Digital Logic Design**

**Paper Code: CS301(Backlog)**

**Full Marks: 70**

**Time: 3 hours**

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**Answer all the questions. Each question is of 7 marks.**

- 1. A.** How synchronous counter is better than asynchronous counter?

**OR**

- B.** Simplify the following using k-map method

$$F(a,b,c,d) = \Sigma m(1,2,4,7,10,11,14)$$

- 2. A.** Find the DeMorgan Equivalent of the function  $F=XY'Z+XZ+XY'+YZ'$

**OR**

- B.** Design a synchronous mod-16 down counter and implement it.

- 3. A.** Design a Mod 5 Asynchronous up counter draw the wave forms. Convert it to Mod 5 type Asynchronous down counter.

**OR**

- B.** Draw and explain the logic diagram of a 3- bit synchronous up/down counter.

- 4. A.** Develop a full adder circuit using two half adders (use any one basic gate if required).

**OR**

- B.** Implement Full Subtractor circuit using 2:1 MUXes and any other basic gates if required.

- 5. A.** Design an asynchronous up counter that will count value from 4 to 6.

**OR**

- B.** What is shift register? Classify different types of shift register.

- 6. A.** Design a MOD 8 synchronous up counter using JK flip flops.

**OR**

- B.** Simplify the following using k-map method  $F(a,b,c,d) = \Sigma m(1,2,5,6,8,10,12,15)$ .

- 7. A.** Draw and explain the operation of BCD ripple counter.

**OR**

- B.** How can a D flip flop converted into a SR flip flop.

- 8. A.** Find the minimal SOP for the Boolean expression,  $F(A,B,C,D) = \Sigma m(1,4,5,9,10,11,13) + \Sigma d(2,12)$

**OR**

- B.** Design a 4-bit Ripple counter (up / down any)

9. A. Design a 4:2 priority encoder with output indicator.  
OR  
B. Minimize the following expression using k-map,  $F(A,B,C,D)=\sum m(1, 2, 3, 4, 6, 7, 12, 13, 15)$
10. A. Draw a clocked master slave JK flip flop using NAND gate and explain the working of it.  
OR  
B. Design and implement a comparator that can compare between two 3-bit binary numbers.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CS)      Semester: 3<sup>rd</sup>**

**Paper Name: Mathematics- III**

**Paper Code: BSC302(Backlog)**

**Full Marks: 70**

**Time: 3 hours**

**Answer all the questions. Each question is of 7 marks.**

1. A. The probability that a pen manufactured by a company will be defective is  $1/10$ . If 12 such pens are manufactured, find the probability that i) exactly two will be defective ii) none will be defective.

**OR**

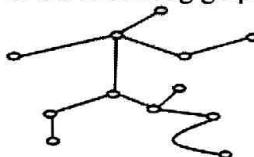
- B. Prove that the chromatic number of a circuit ( $C_n$ ) with  $n$  vertices is

- i) 2 if  $n$  is even  
ii) 3 if  $n$  is odd

2. A. The expected number of typographical errors on a page of a certain magazine is 0.3. What is the probability that the next page you read contains one or more typographical errors?

**OR**

- B. Find the chromatic polynomial of the following graph G.



3. A. In a bolt factory, machines A, B and C manufacture respectively 25%, 35% and 40% of the total output of which 5%, 4% and 2% are defective bolts. A bolt is drawn at random and is found to be defective. What are the probabilities that it has been manufactured by machine A, B and C?

**OR**

- B. State and prove Euler's Formula.

4. A. In a certain city, the daily consumption of electric power (in millions of kilowatt hours)

$$\text{is a random variable having the pdf } f(x) = \begin{cases} \frac{1}{9}xe^{-x^2}, & x > 0 \\ 0, & x \leq 0 \end{cases}$$

If the city's power plant has a daily capacity of 12 million kilowatt hours, what is the probability that this power supply will be in adequate on any given day?

**OR**

- B. How many ways a tree on 7 vertices can be colored with at most 5 colors?

5. A. If the weekly wage of 10,000 workers in a factory follows normal distribution with mean and s.d Rs. 70 and Rs 5 respectively, find the expected number of workers whose weekly wages are i) between Rs. 66 and 72 ii) less than Rs. 66 iii) more than Rs. 72

[Given that  $\frac{1}{\sqrt{2\pi}} \int_0^z e^{-\frac{t^2}{2}} dt = 0.1554$  and 0.2881 according as  $z = 0.4$  and  $z = 0.8$  ]

**OR**

- B. Find the inverse of  $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 4 & 3 & 1 & 2 \end{bmatrix}$  and  $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \end{bmatrix}$ .

6. A. A fair coin is tossed 400 times. Using normal approximation to binomial distribution find the probability of obtaining i) exactly 200 heads ii) between 190 to 210 heads. Given that the area under standard normal curve between  $z = 0$  and  $z = 0.05$  is 0.0199 and between  $z = 0$  and  $z = 1.05$  is 0.3531.

**OR**

- B. Let  $G = (\mathbb{Z}, +)$  and  $G' = (2\mathbb{Z}, +)$  be two groups. Let  $f$  be a mapping defined by  $f(t) = -3t$ ,  $t \in G$ . Then show that  $f$  is an isomorphism.

7. A. The probability of a missile hitting a target is  $\frac{1}{4}$ .

- i) If 7 such missiles are sent, what is the probability of hitting the target at least twice  
ii) How many missiles must be fired so that the probability of hitting the target at least once is more than  $\frac{2}{3}$ .

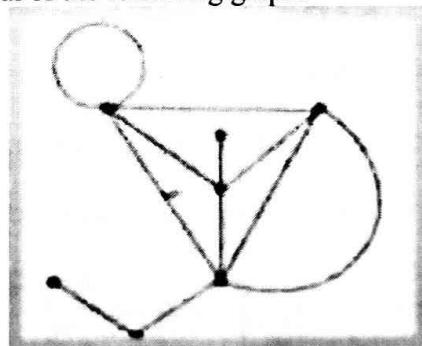
**OR**

- B. Show that every proper subgroup of order 35 is cyclic.

8. A. Prove that every cyclic group is Abelian group but converse is not true.

**OR**

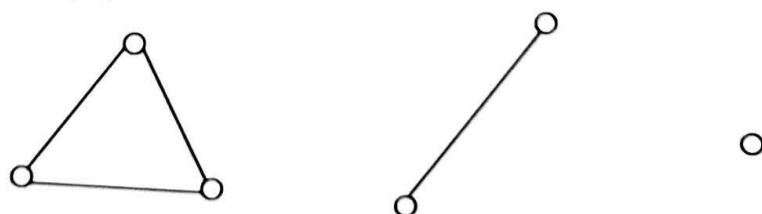
- B. Find the dual of the following graph.



9. A. Find all cyclic subgroups of the group  $(\mathbb{Z}_7, +)$

**OR**

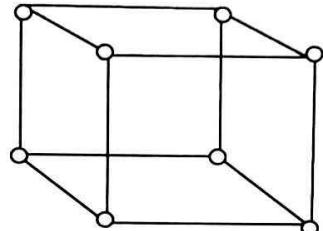
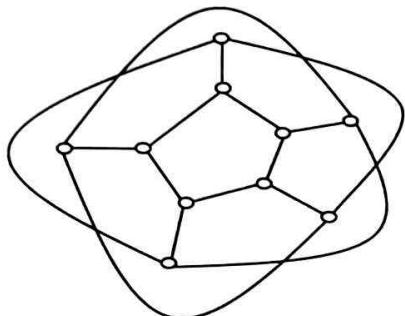
- B. Find the chromatic polynomial and hence find the chromatic number for the following graph.



**10. A.** Let  $S$  be set of all real matrices  $\begin{pmatrix} a & b \\ -b & a \end{pmatrix} : a^2 + b^2 = 1\}$ . Show that  $S$  forms a commutative group under matrix multiplication.

**OR**

**B.** State the Kuratowski's theorem; hence show that the following graphs are non-planar.



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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CS) Semester: 3<sup>rd</sup>**

**Paper Name: Data Structure & Algorithm**

**Paper Code: PCCCS302(Backlog)**

**Full Marks: 70**

**Time: 3 hours**

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**Answer all the questions. Each question is of 7 marks.**

1. A. Draw a binary tree with the following inputs: 5,7,4,3,4,6,9,12,10,11,14,15. Perform tree traversal in all order (in, pre & post).  
**OR**  
B. "A tree can be reconstructed from any two traversals." Justify the statement.
2. A. Write a C program to find the 2nd highest element in an array.(Don't use sorting)  
**OR**  
B. Write an algorithm to implement stack using array.
3. A. Prove that i) Number of nodes in any level is related to the height of the tree.  
ii) Number of nodes = number of edges + 1  
**OR**  
B. Draw the expression tree for the following postfix expression- AK+N-FA\*%E/ (use stack)
4. A. Explain the collision resolution technique using suitable example.  
**OR**  
B. Show how the following numbers can be inserted in an empty binary search tree in the given order-- 13, 6, 18, 2, 14, 19, 10, 34. Delete root and again draw. Show the building of the tree stepwise.
5. A. Write an algorithm for insertion and deletion of an element in a circular queue using array representation  
**OR**  
B. Write an algorithm for insertion and deletion of an element in a double ended queue.
6. A. Write an algorithm to perform end-wise swapping of nodes of a doubly linked list.  
**OR**  
B. Write an algorithm to reverse a Singly Linked List is.
7. A. Create B tree of order 5 from the following lists of data items-  
4,2,9,5,10,45,78,22,33,31,56,45,46,76.  
**OR**

- B. Perform heap sort on the following: D,F,R,A,O,P,Y,U,W,X,W,L,K.
8. A. Differentiate between BFS & DFS with an example.  
**OR**  
 B. Write a C function to create a mirror image of a binary search tree.
9. A. Write a C function to delete starting and ending node in a circular linked list.  
**OR**  
 B. Explain the method of calculating time complexity of any algorithm.
10. A. Write merge sort algorithm and apply it for the following inputs:  
 15,5,7,8,9,19,10,12,22,27,23,56,45,67,89,78.  
**OR**  
 B. Obtain the Huffman coding for following characters. Also calculate the percentage of memory that can be saved.

Data Item	A	B	Q	K	E	M	G	N	I
Weight	36	5	7	13	35	7	8	5	30

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CS) Semester: 3<sup>rd</sup>**

**Paper Name: Data Structure & Algorithm**

**Paper Code: CS302(Backlog)**

**Full Marks: 70**

**Time: 3 hours**

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**Answer all the questions. Each question is of 7 marks.**

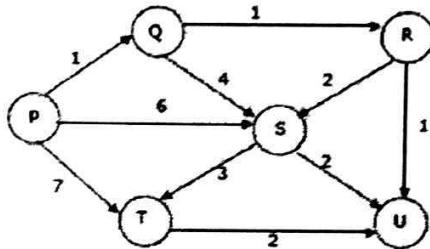
1. A. Write a C program to insert a specific element in a sorted array.  
**OR**  
B. Write a C program to convert an infix expression to postfix with the help of stack.
2. A. Write a C program to implement doubly linked list.  
**OR**  
B. Explain concept of tree recursion using an example.
3. A. Write an algorithm to implement shell sort.  
**OR**  
B. Explain the relationship among all the asymptotic notations.
4. A. Write an algorithm to perform DFS of a graph.  
**OR**  
B. Take your full name as input and draw a balanced binary search tree.
5. A. Insert the following key into a B tree of order 5:  
23,6,34,2,8,5,4,9,12,67,45,34,98,33,65,54,43. Then delete 2 & 65.  
**OR**  
B. Insert the following data into an empty BST- 8,5,4,8,7,3,4,6,10,2.  
Then delete the following- 3,8.
6. A. Write the algorithms for binary search. Explain using example.  
**OR**  
B. Evaluate the following postfix expression using stack:  
10, 4, -, 5, 2, ↑, +, 6, 5, 2, /, 7, \*, -, +.
7. A. Construct the Heap tree for a calendar where nodes are entering in the following order- MARCH,MAY,NOVEMBER,AUGUST,APRIL,JANUARY,DECEMBER,JULY,FEBRUARY,JUNE,OCTOBER AND SEPTEMBER.  
**OR**  
B. Prove that array representation is not good for a general tree.

8. A. Construct a Huffman tree with the following data-  
a-35, b-23, c-22, d-6, e-29, f-7,g-2, h-4, j-3. Find out the codes for each of the given alphabets.

OR

- B. Define chaining.  $H(k) = k \bmod 7$ , hash table has 9 slots, chaining is used. Keys are inserted in the order: 15, 18, 19, 25, 10, 23, 22, 7, 30.

9. A. Find all pair shortest path for the given graph.



OR

- B. Perform BFS between P & U for the above graph.

10. A. Compare the performance of Prim's & Kruskal algorithm to find a MST.

OR

- B. Explain circular queue with an example.

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CSE) Semester: 3<sup>rd</sup>**

**Paper Name: Mathematics - III**

**Paper Code: M301(Backlog)**

**Full Marks: 70**

**Time: 3 hours**

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**Answer all the questions. Each question is of 7 marks.**

1. A. The probability that a pen manufactured by a company will be defective is  $1/10$ . If 12 such pens are manufactured, find the probability that i) exactly two will be defective ii) none will be defective.

**OR**

- B. For a binary communication channel, probability that a transmitted “0” is received as a “0” is 0.95 and the probability that a transmitted “1” is received as a “1” is 0.90. If the probability that a “0” is transmitted is 0.4, find the probability that i) a “1” is received ii) a “1” is transmitted given that a “1” is received.

2. A. A random variable X has following pdf

$$f(x) = \begin{cases} \frac{1}{40} e^{-\frac{x}{40}}, & x > 0 \\ 0, & x \leq 0 \end{cases}$$

Find i)  $P(X \leq 20)$  ii)  $P(32 \leq X \leq 48)$  iii)  $P(X \geq 25)$ .

**OR**

- B. A random variable X has the density function

$$f(x) = \frac{a}{x^2+1}, -\infty < x < \infty.$$

Find i) a ii) the probability that  $X^2$  lies between  $\frac{1}{3}$  and 1 iii) the distribution function of X.

3. A. Show that the function  $f(x) = \frac{x^n e^{-x}}{n!}, x > 0$  where n is a positive integer, is a pdf.

Compute mean and variance?

**OR**

- B. The probability density function of a random variable X is

$f(x) = k(x-1)(2-x), 1 \leq x \leq 2$ . Determine i) the value of k; ii) the distribution function  $F(x)$  iii)  $P\left(\frac{5}{4} \leq X \leq \frac{3}{2}\right)$

4. A. The length of bolts produced by a machine is normally distributed with mean 4 and s.d. 0.5. A bolt is defective if its length does not lie in the interval (3.8,4.3). Find the percentage of defective bolts produced by the machine.

$$\left[ \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{0.6} e^{-\frac{t^2}{2}} dt = 0.7257, \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{0.4} e^{-\frac{t^2}{2}} dt = 0.6554 \right]$$

**OR**

- B. The probability that a pen manufactured by a company will be defective is  $\frac{1}{10}$ . If 12 such pens are manufactured find the probability that i) exactly two will be defective ii) none will be defective iii) at least one will be defective.

5. A. Show that a group  $(G, \circ)$  is commutative if and only if  $(a \circ b)^2 = a^2 \circ b^2$ .

**OR**

- B. Show that the set  $G$  of all ordered pairs  $(a, b)$  with  $a \neq 0$ , of real numbers  $a, b$  forms a group with operation '  $\circ$ ' defined by  $(a, b) \circ (c, d) = (ac, bc + d)$ .

6. A. Prove that a group  $(G, *)$  is abelian if and only if  $(a * b)^{-1} = a^{-1} * b^{-1}$  for all  $a, b \in G$ .

**OR**

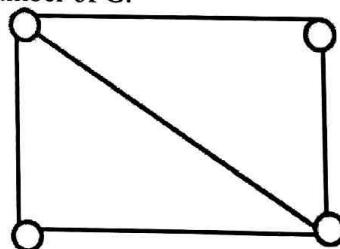
- B. Let  $S$  be set of all real matrices  $\left\{ \begin{pmatrix} a & b \\ -b & a \end{pmatrix} : a^2 + b^2 = 1 \right\}$ . Show that  $S$  forms a commutative group under matrix multiplication.

7. A. Let  $G = (\mathbb{Z}, +)$ . Then verify the mapping  $\varphi: G \rightarrow G$  defined by  $f(x) = x + 1$  is a homomorphism or not.

**OR**

- B. Show that every group of order seven is Abelian.

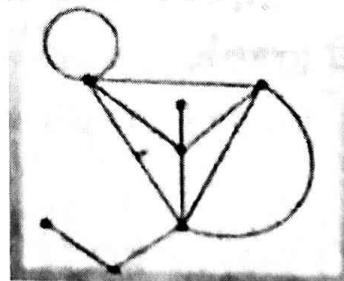
8. A. Find using decomposition theorem, the chromatic polynomial of the following graph and hence find the chromatic number of  $G$ .



**OR**

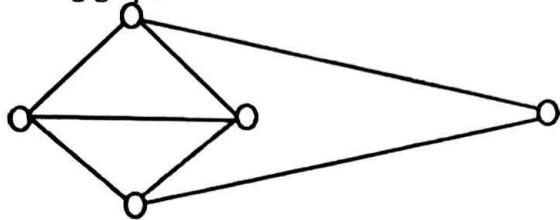
- B. For each graph  $G$ , the constant term in its chromatic polynomial is zero.

9. A. Find the dual of the following graph

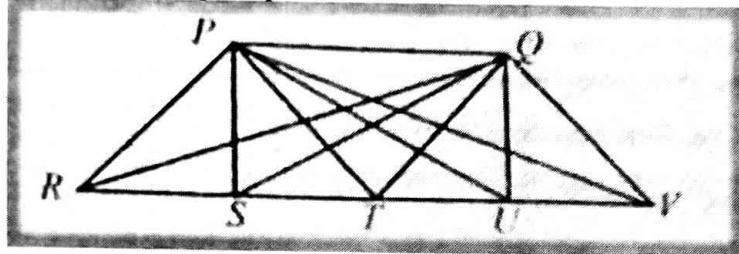


**OR**

**B.** Find dual of the following graph



**10. A.** Show that the following graph is planar



**OR**

**B.** Let  $G$  be a simple connected planar graph with  $n$  vertices,  $e$  edges and  $f$  regions.

$$\text{Then i) } e \geq \frac{3}{2}f \text{ ii) } e \leq 3n - 6.$$

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**University of Engineering & Management, Kolkata**

**End Semester Examination, February 2021**

**Course: B.Tech(CS) Semester: 3<sup>rd</sup>**

**Paper Name: Digital Logic Design**

**Paper Code: ESC301(Backlog)**

**Full Marks: 70**

**Time: 3 hours**

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**Answer all the questions. Each question is of 7 marks.**

- 1. A.** Draw and explain a 3 to 8 line decoder using NOT and NAND gates only. Mention the advantages of Decoder over Demultiplexer gate.

**OR**

- B.** Define Multiplexer. Implement the expression using a multiplexer along with the truth table:  $f(A,B,C,D) = \Sigma M(1,4,5,6,7,8,9,11,12,13)$ .

- 2. A.** Design a Binary to Gray code converter and convert the number 101110110 from binary to gray code.

**OR**

- B.** Draw the logic diagram of a 1 bit full Adder using only NAND gate and explain the truth table.

- 3. A.** Explain the multiple toggle of a JK flip flop. How can this condition be avoided? With the help of a diagram, explain the working of a T and D flip flop.

**OR**

- B.** Design the following function using suitable MUX:  $F(A, B, C, D) = \sum (1,3,4,5,11,13,14)$ .

- 4. A.** Design a 2 bit ring counter and explain its operation. What is to be done to make it a Johnson counter? Explain.

**OR**

- B.** Design a full subtractor using two half subtractors. What is the function of borrow in subtractor?

- 5. A.** What is ripple counter? Design a preset table 3-Bit up asynchronous counter using R S flip-flop.

**OR**

- B.** A binary ripple counter is required to count up to  $(256)_{10}$ . How many flip-flops are required? If the clock frequency is 8-192 MHz, what is the frequency at the output of the MSB?

6. A. Design and explain a XS-3 to BCD code converter and draw the logic diagram only using basic gates.  
**OR**  
B. Draw and explain the working principle of a 3 bit parallel adder. What is the advantage of carry look ahead adder? What are its disadvantages?
7. A. Implement with a proper explanation a Full Adder circuit using Multiplexer along with the truth table.  
**OR**  
B. Create a excitation table for converting a SR flip flop to a D flip flop. Show the diagram and explain its operation.
8. A. State and prove DeMorgan's theorem and expand the function  
$$(A'+B'C+D')' + (C+A'D)'$$
  
**OR**  
B. Design a 3 bit Universal shift register using flip flops and explain its operation using proper clock diagram.
9. A. Simplify  $F(A,B,C,D) = \Sigma (1,4,8,10,12,13,14) + \Phi (3,5,11)$   
**OR**  
B. Design an 4 bit asynchronous up down counter and explain its operation using suitable excitation table.
10. A. Prove the following:  
A positive logic OR operation is equivalent to a negative logic AND operation and vice-versa.  
**OR**  
B. Design a MOD 8 synchronous down counter.

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