

N.C.I.T.
Sample questions

Level: Bachelor	semester: Fall	Year:2022
Programme : SE		Full Marks:100
Course: Engineering mathematics 1		Pass marks: 45
SET: A		Time : 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all questions.

1 (a) If $y = \log \left(x + \sqrt{a^2 + x^2} \right)$, show that

(i). $(x^2 + a^2)y_2 + xy_1 = 0$, (ii). $(x^2 + a^2)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$ [5]

(b) Evaluate $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x} \right)^{\frac{1}{x^2}}$ [5]

(c) Find the expansion of $\log \sec x$ in Maclaurin's series . [5]

2 (a) Find asymptotes of the curve: $(x^2 - y^2)^2 - 2(x^2 + y^2) + x - 1 = 0$ [8]

OR

Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at $(0, 0)$.

(b) Find reduction formula for : $\int \sin^n x dx$ and evaluate $\int \sin^7 x dx$ [7]

OR

Evaluate: $\int_0^1 x^6 (1-x^2)^{\frac{1}{2}} dx$

3 (a) Integrate: $\int \frac{1}{3 \sin x + 4 \cos x} dx$ [5]

(b) Evaluate: $\int_0^1 \frac{\log(1+x)}{1+x^2} dx$ [5]

(c) Find the area bounded by $y^2 + x = 0$ and $3y^2 + x = 2$ [5]

4 (a) Find the volume of solid generated by revolution of the region bounded by $y^2 = x$, $y = 1$, $x = 4$ about $y=1$ [7]

OR

Find the area of the surface generated by revolving the curve $y = \sqrt{x}$, $4 \leq x \leq 9$ about x-axis .

(b) Find the dimension of rectangular box open at the top of maximum volume whose surface area is 432 square centimeter [8]

OR

Find the shortest and longest distance from the point (1, 2, -1) to the sphere $x^2 + y^2 + z^2 = 24$

5 (a) Solve: $\frac{dy}{dx} + \frac{y}{x} \log y = \frac{y(\log y)^2}{x^2}$ [7]

(b) A tank initially contains 40 kg of salt dissolved in 200 liters of water. Suppose that the salt solution 2kg of salt per liter is allowed to enter the tank at a rate of 5 liter/min and the uniform solution is drained from the tank at the same rate. Find the amount of salt in the tank after 30 minutes. [8]

6 (a) Solve: $y'' - 2y' + y = 3e^x x^{\frac{3}{2}}$. [7]

(b) Solve: $y'' - 6y' + 13y = 4e^{3x}$; $y(0) = 2$, $y'(0) = 4$. [8]

7. Answer the following. (2×5)

(a) Find nth order derivative of $y = \frac{1}{3x+2}$

(b) Plot parametric curve $x = \cos 2t$, $y = \sin 2t$, $0 \leq t \leq 2\pi$

(c) If $\sin u = \frac{x^2 - y^2}{x^2 + y^2}$. Find value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$

(d). Verify Euler's theorem for $f(x; y) = \sqrt{x^3 + y^3}$

(e) Find arc length of parabola $y = x^2$, from $x = -4$ to $x = 4$.

N.C.I.T.
Sample questions

Level: Bachelor semester: Fall

Year: 2022

Programme: SE

Full Marks: 100

Course: Engineering mathematics 1

Pass marks: 45

SET: B

Time : 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all questions.

1 (a) Prove that differentiability of the function $f(x)$ at $x=a$ implies continuity at $x=a$. But converse is not always true. [5]

OR

Check the continuity and differentiability of the function

$$f(x) = \begin{cases} x, & \text{for } x < 1 \\ 2 - x, & \text{for } 1 \leq x < 2 \\ -2 + 3x - x^2 & \end{cases}$$

At $x=1$ and $x=2$.

(b) Show that $\frac{b-a}{b} < \log\left(\frac{b}{a}\right) < \frac{b-a}{a}$ by using Lagrange's Mean value theorem. [5]

(c) Find the expansion of $\sec x$ in Maclaurin's series. [5]

2 (a) Find asymptotes of the curve: $x^2(x-y)^2 - a^2(x^2 + y^2) = 0$ [8]

OR

Find the radius of curvature of the curve $x^3 + y^3 = 3axy$ at $(0, 0)$.

(b) Find reduction formula for: $\int_0^{\frac{\pi}{2}} \cos^n x dx$ and evaluate $\int_0^{\frac{\pi}{2}} \cos^7 x dx$ [7]

3 (a) Integrate: $\int \frac{xe^x}{(x+1)^2} dx$ [5]

(b) Evaluate: $\int_0^1 \frac{\log x}{\sqrt{1-x^2}} dx$ [5]

(c) Find the area bounded by $y + x = 2$, on the left $y = x^2$ and below by x-axis [5]

- 4 (a) Find the volume of solid generated by revolution of the region bounded by $x^2 = 4y$ and $y = |x|$ about $y = -2$ [7]

OR

Find the area of the surface generated by revolving the curve $y^2 = x$, $4 \leq x \leq 9$ about x-axis.

- (b) Find absolute maxima and minima of $f(x, y) = x^2 + y^2 - 2x$ in triangular region with vertices (2, 0), (0, 2) and (0, -2).

OR

If the sum of dimension of a rectangular pool is given. Prove that the amount of water in the pool is maximum when it is cube. [8]

- 5 (a) Solve: $\frac{dy}{dx} + \frac{y}{x} \log y = \frac{y(\log y)^2}{x^2}$ [7]

- (b) Define Riccati's equation. Solve $\frac{dy}{dx} = y^2 - \frac{y}{x} - \frac{1}{x^2}$; $y(1) = 2$ [8]

- 6 (a) Solve: $x^2 y'' - xy' + 2y = x \log x$. [7]

- (b) Solve: $y'' + 2y' + y = e^{-x}$; $y(0) = -1$, $y'(0) = 1$. [8]

7. Answer the following : (2×5)

- (a) Find nth order derivative of $y = (a - bx)^m$

- (b) Plot parametric curve $x^2 y^2 = x^2 - 1$

- (c) If $\sin u = \frac{x^2 - y^2}{x^2 + y^2}$. Find value of $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$

- (d). Verify Euler's theorem for $u = \log \left(\frac{x^2 + y^2}{xy} \right)$

- (e) Find arc length of parabola $y = \cos x$, from $x = 0$ to $\frac{\pi}{2}$

MODEL QUESTION

Level: Bachelor	Semester – Spring	Year : 2023
Programme: BESE, BECE		Full Marks: 100
Course: Digital Logic		Pass Marks: 45
First Year: First Semester		Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Explain how Digital and Analog electronic systems are different. Also list out the advantages of digital system. 5
- b) Perform the following operation using 9's complement and 2's complement method. 5
 - i) $(743)_{10} - (234)_{10}$
 - ii) $(234)_{10} - (743)_{10}$
- c) Convert the following numbers from the given base to the other bases indicated. 5
 - i) $(11001.111)_2 = ()_8$
 - ii) $(5FE.DD)_{16} = ()_8$
 - iii) $(203)_8 = ()_4$
 - iv) $(777)_8 = ()_{16}$
 - v) $(1100)_{\text{GRAY CODE}} = ()_2$
2. a) Simplify the following function F using don't care conditions d, in (1) sum of products and (2) product of sums using K-map 5
 - i) $F = A'B'D' + A'CD + A'BC$
 $d = A'BC'D + ACD + AB'D'$
- b) State and verify De-Morgan's theorem for two variables using truth table. 5
- c) Write down the differences between combinational logic and sequential logic. 5

3. a) Use Boolean theorems and postulates to simplify the following function and realize the simplified form using NAND gates only. 7

$$F = AB + A'C + BC$$

- b) Design a code converter circuit which converts 3 bit Code to GRAY CODE and draw the logic diagram. 8

OR

Design a 3 bit odd parity generator and 4 bit parity checker using exclusive gates.

4. a) What do you mean by DE-Multiplexer? Implement the following Boolean function $F(w, x, y, z) = \sum_m(1, 2, 5, 7, 11, 15)$ using 8 to 1 Multiplexer with w, x, y as selection lines S_2, S_1 and S_0 respectively. 4

- b) Implement the following functions using ROM. 4

$$F_1(X, Y) = \sum(0, 2, 3)$$

$$F_2(X, Y) = \sum(1, 2)$$

- c) A combinational circuit is defined by the function 7

$$F_1(X, Y) = XY' + XZ \text{ and } F_2(X, Y) = XZ + YZ$$

Implement the circuit with a PLA having three inputs, three product terms and two outputs.

5. a) Explain JK Flip with its logic diagram, truth table and characteristics equation. 5

- b) Use 'D' flip-flop to design a 3-bit Synchronous UP Counter. 5

- c) Convert the JK Flip flop to realize D Flip flop. 5

6. a) A sequential circuit with two D Flip flops, A and B; two inputs, x and y; and one output, z, is specified by the next state and output equations: 8

$$A(t+1) = x'y + xA$$

$$B(t+1) = x'B + xA$$

$$\text{and } z = B$$

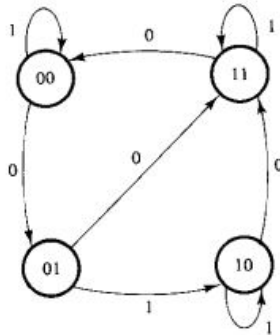
- i) Draw Logic diagram of the circuit. 7

- ii) Derive state table

iii) Draw state diagram

OR

Draw the sequential circuit from the information provided in the state diagram in the figure below using D flip-flops.



b) Design a 4-bit arithmetic circuits which performs eight different arithmetic operations.

7. Write short notes on: (**Any Two**)

2×5

- a) Output Hazard
- b) RAM
- c) Shift Register

MODEL QUESTION

Level: Bachelor	Semester – Spring	Year : 2023
Programme: BESE, BECE		Full Marks: 100
Course: Digital Logic		Pass Marks: 45
First Year: First Semester		Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) List out the advantages of digital system over analog systems. Give some examples if digital system applications. 5
 - b) Perform the following operation using 9's complement and 2's complement method. 5
 - i) $(203)_{10} - (103)_{10}$
 - ii) $(103)_{10} - (203)_{10}$
 - c) Convert the following numbers from the given base to the other bases indicated. 5
 - i) $(110011.101)_2 = ()_8$
 - ii) $(2FE.CC)_{16} = ()_8$
 - iii) $(123)_8 = ()_6$
 - iv) $(776)_8 = ()_{16}$
 - v) $(1101)_{\text{GRAY CODE}} = ()_2$
-
2. a) Simplify the following function F in (1) sum of products and (2) product of sums using K-map 5
 - i) $F(A,B,C,D) = \Sigma (0,1,2,,6,11,13,14)$
 - b) Find out the complement of the following function and draw the logic diagram using basic gates. 5
 - i) $F(x, y, z) = (x + y' + z)(x' + z')(x + y)$
 - c) Write down the differences between combinational logic and sequential logic.

3. a) Design BCD to Excess-3 code converter and draw the logic diagram. 7
- b) Explain two bit magnitude comparator and draw the circuit diagram. 8
4. a) What do you mean by Multiplexer? Implement the following Boolean function $F(w, x, y, z) = \sum_m(1, 2, 5, 7, 11, 15)$ using 8 to 1 Multiplexer with x, y, z as selection lines S_2, S_1 and S_0 respectively. 4
- b) Implement Full Adder using ROM. 4

OR

A combinational circuit is defined by the function

$$F_1(X, Y) = XY + XZ' \text{ and } F_2(X, Y) = XZ' + YZ$$

Implement the circuit with a PLA having three inputs, three product terms and two outputs.

- c) What do you mean by decoder? Design a 4 to 2 line priority encoder and draw the circuit diagram. 7
5. a) Explain the working principle of T Flip with its logic diagram, truth table, characteristics table and excitation table. 5
- b) Use 'T' flip-flop to design a 3-bit Synchronous UP Counter. 5
- c) Convert the JK Flip flop to realize T Flip flop. 5
6. a) A sequential circuit with two T Flip flops, A and B; two inputs, x and y; and one output, z, is specified by the next state and output equations: 8

$$A(t+1) = x'y + xA$$

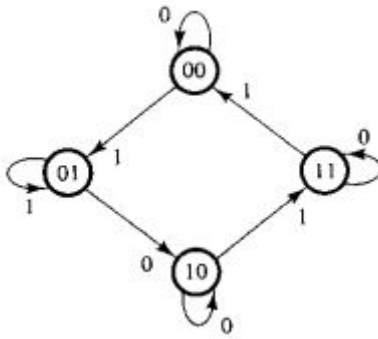
$$B(t+1) = x'B + xA$$

$$\text{and } z = B$$

- i) Draw Logic diagram of the circuit. 7
- ii) Derive state table
- iii) Draw state diagram

OR

Draw the sequential circuit from the information provided in the state diagram in the figure below using JK flip-flops.



b) Design a 4-bit arithmetic circuits which performs eight different arithmetic operations.

7. Write short notes on: (**Any Two**)

2×5

- a) Output Hazard
- b) Shift Register
- c) Status Register

NEPAL COLLEGE OF INFORMATION TECHNOLOGY

Model Set: I

Program : BE SE
Semester : I
Subject : DS

Time : 3 hrs
FM: 100
PM: 45

- ✓ Candidates are requested to give their answer as far as practicable in their own words.
- ✓ Attempt all questions
- ✓ Figure on the margin indicates full marks

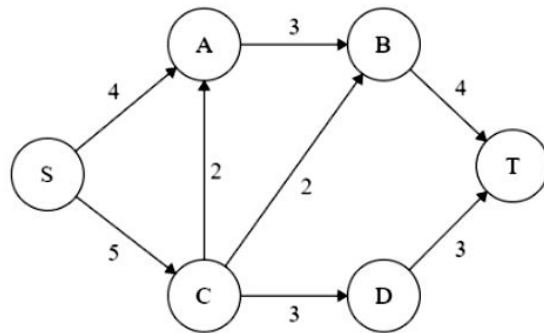
1. (a) In a renowned software development company of 240 computer programmers 102 employees are proficient in Java, 86 in C#, 126 in Python, 41 in C# and Java, 37 in Java and Python, 23 in C# and Python, and just 10 programmers are proficient in all three languages. [5]
 - i) How many computer programmers are there those are not proficient in any of these three languages?
 - ii) How many are proficient in Java only.(b) Express the GCD of 56 and 15 as linear combination of 56 and 15. [5](c) A coin is flipped 10 times where each flip comes up either heads or tails. How many possible outcomes: [5]
 - i) Contain at most three tails? (ii) Contain the same number of heads and tails?
2. (a) Define closure of a relation. Let $A = \{1, 2, 3, 4\}$ and let $R = \{(1, 2), (2, 3), (3, 4), (2, 1)\}$. Find the transitive closure of R using warshall's algorithm. [7](b) Solve the recurrence relation: $a_n - 6a_{n-1} + 8a_{n-2} = 3$; $a_0 = 10, a_1 = 25$. [8]
3. (a) What is Logical Equivalence? Find converse, contrapositive, and inverse of: "If it snows tonight, then I will stay at home." [7](b) Show that the premises "There is someone in this class who has been to Pokhara." "Everyone who goes to Pokhara visit Sarankot." imply the conclusion "Someone in this class has visited Sarankot." [8]
4. (a) Use Mathematical induction to show that: $8^n - 3^n$ is divisible by 5. [7](b) Differentiate between universally quantified and existentially quantified statement. What is the truth value of the statement, for every real number $x, x^2 - 1 > 0$. [8]
5. (a) Prove that a graph has Euler trail but not Eulerian circuit if and only if it has exactly two vertices of odd degree and rest vertices of even degree. [7]

OR

When is $K_{m,n}$ graph Hamiltonian where 'm' and 'n' are positive integers?

(b) Find the maximum flow in the given network:

[8]



6. (a) Design a finite state automata that accepts only those strings over $\{0, 1\}$ that ends with 11 and contains even number of 1's and other strings over $\{0, 1\}$ should be rejected. Your design should include the proper definition of the finite-state automation, transition table and the transition diagram. [7]

(b) Let $G = \{N, T, S, P\}$, where $N = \{A, B, C\}$, $T = \{a, b, c\}$, $S = A$ and $P =$ production rule given by:

$A \rightarrow aaA, A \rightarrow bB, B \rightarrow cCb, B \rightarrow cb, C \rightarrow bbC, C \rightarrow bb.$

State which of the following are in $L(G)$?

[8]

- i) aabcb ii) abbcb iii) aaaabcb iv) aaaabcb v) abcbcb

OR

Explain Chomsky Hierarchy of grammar in detail.

7. Write short notes on (any two): [2*5]

- (a) Bijective Function
(b) Regular Expressions
(c) POSET

NEPAL COLLEGE OF INFORMATION TECHNOLOGY

Model Set: II

Program : BE SE
Semester : I
Subject : DS

Time : 3 hrs
FM: 100
PM: 45

- ✓ Candidates are requested to give their answer as far as practicable in their own words.
- ✓ Attempt all questions
- ✓ Figure on the margin indicates full marks

1. (a) Explain the Hamiltonian path and Hamiltonian circuit with the help of a diagram. State the necessary and sufficient conditions for Euler circuits and paths. How is Euler circuit different from the Hamiltonian circuit? [8]
- (b) What is chromatic number of a complete graph and bipartite graph? Explain real world application of graph theory. [7]

OR

Explain different techniques of Graph Representation.

2. (a) Define the terms Tautology, Contradiction and Logical Equivalences. Show that Implication and Contrapositive are Logically Equivalent. State the converse, contrapositive and Inverse of the statement: "A positive integer is prime only if it has no divisors other than 1 and itself." [8]
- (b) Using rules of inferences, show that the hypotheses "if you send me an e-mail message, then I will finish writing the program," "if you do not send me an e-mail message, then I will go to sleep early," and "If I go to sleep early, then I will wake up feeling refreshed" lead to the conclusion "If I do not finish writing the program, then I will wake up feeling refreshed." [7]
3. (a) Translate the following statement using quantifiers and logical connectives: [8]
- i. Some student in your class has voted for Balen.
 - ii. Everyone who sees Mary loves Mary.
 - iii. A goal without plan is just a dream.
 - iv. Behind every successful man there is a women.

OR

Use Mathematical induction to show that:

$2 - 2.7 + 2.72 + \dots + 2.(-7)^n = [1 - (-7)^{n+1}]/4$ whenever n is positive integer.

- (b) Solve Tower of Hanoi puzzle using iterative approach. [8]
4. (a) Solve: $a_n - 6a_{n-1} + 8a_{n-2} = 3$ with initial condition $a_0 = 10$, $a_1 = 25$. [7]
- (b) What is an Equivalence relation. Let 'm' be an integer with $m > 1$. Show that the relation $R = \{(a, b) \mid a \equiv b \pmod{m}\}$ is an equivalence relation on the set of integers. [8]

5. (a) What are key differences between DFA and NFA? Design a Deterministic finite automata that accepts all those strings that starts and ends with different symbol over (a, b). [8]
- (b) Define grammar with an example. Write regular expression for following languages and convert it into equivalent Automata. [7]
- i. $L = \{w: w \text{ starts with 'a' and ends with 'b' over } (a, b)\}$
 - ii. $L = \{w: \text{second symbol of } w \text{ is '0' and fourth symbol is '1' over } (0, 1)\}$
6. (a) What is pigeonhole principle? How many cards must be selected from a standard deck of 52 cards to guarantee that: [5]
- a) At least three cards of the same suit are chosen?
 - b) At least three cards of same value are selected?
- (b) Define injective and surjective function. Determine whether a function $f(x) = 2x + 3$ from the set of real numbers to the set of real numbers is bijective? [5]
- (c) Explain computer representation of sets and set operations. [5]
7. Write short notes on (any two): [2*5]
- (a) Indirect proof
 - (b) Transport Network
 - (c) Predicate Logic

Model Question

NEPAL COLLEGE OF INFORMATION TECHNOLOGY

Level: Bachelor

Program: BE

Course: Problem Solving Techniques

Candidates are required to give their answers in their own words as far as practicable.

Attempt all the questions.

1. a) There are m numbers of computers and $m+1$ number of students in a 'Programming in C' lab. Verify that one computer must be shared by at least two students. 7

OR

A watermelon weighs 500 pounds. It turns out that 99% of the weight of the watermelon is due to water in the watermelon. After the watermelon has sat in a drying room for a while, it turns out that it is only 98% water by weight. How much does it weigh now?

- b) A martini is made by mixing k parts gin with 1 part vermouth. Gin is usually 40% alcohol while vermouth is 20% alcohol. A martini is said to be dry if it contains relatively little vermouth. For instance, if $k = 15$ then the martini is said to be dry. If instead $k = 5$, then the martini is said to be sweet. Discuss by calculating the amount of alcohol in a dry martini vs sweet martini, which one is better? 8

OR

A new car is equipped with three fuel saving devices. Device A, by itself, saves 25% on fuel; device B, by itself, saves 45% on fuel and device C, by itself saves 30% on fuel. Now suppose that the three devices are used together and that they act independently. Will the combination save $20+45+30=100\%$ on fuel? What is the correct answer?

2. a) A cube of a side r is inscribed in a sphere. The sphere is inscribed in a cone with side length equal to the diameter of its base. The cone is inscribed in a right circular cylinder. What is the surface area of the cylinder? 8
 b) There are two married couples that need to cross a river. A small boat is available that will hold just two people at a time. The males involved are quite jealous. No woman can be left with a man unless her husband is also present. There are no other constraints. How can these four people cross the river? What is the fewest numbers of trips possible? 7
3. a) A certain number k is a multiple of 9. Add the digits together. If the result has more than one digit, add those together. Continue adding digits together until you have a one digit answer. It will be a 9. Explain why this is so? 8
 b) Suppose that you have a 9 quart container and a 4 quart container. How can you put exactly 6 quart of water into the large container. 7
4. a) A ten foot pole is dropped into a milling saw and randomly cut into three shorter poles. What is the probability that these three pieces will form a triangle? 7
 b) A 10 years old child puts Rs. 100000 in the bank. She intended with withdraw the money on her 21st birthday. Which one scheme is better for her?
- i. An account with 5% interest compounded daily
 ii. An account with 5.1% interest compounded weekly. 8
5. a) A game is played by two players. They begin with a pile of thirty chips, all the same. For his or her move, a player may remove 1 to 6 chips. The player who removes the last chip wins. What strategy can the first player use so that he will always win? 7
 b) Examine the equations

$$1 = 1$$

$$2+3 + 4 = 1+8$$

$$5+6+7+8+9 = 8+27$$

$$10+11+12+\dots+16 = 27+64$$
 Determine the pattern and prove the identity. 8
6. a) It begins snowing some time before noon. The snowfall steadily, when measured by the rate of change of depth. At exactly noon, a snow plow begins working at a steady rate (in terms of cubic feet of snow removed per hour). The plow clears two blocks during the first hour of work, and one block during the second hour. At what time did it begin snowing? 8

OR

Construct an 8×8 magic square and explain the constructing process.

b) Suppose that you have 9 pearls. They all look the same, but 8 of have equal weight and one is different. The odd pearl is either lighter or heavier, you do not know which. The only equipment that you have at hand is a balance scale. How can you use the scale to find the odd pearl In just three weighing?

7

OR

Solve the following crypto arithmetic problem:

$$\begin{array}{r} CROSS \\ +ROADS \\ \hline DANGER \end{array}$$

7. Answer any two questions: $(2 \times 5 = 10)$

a) Suppose that S is a set with k elements. Show that S has precisely 2^k subsets.

b) How many zeros end the number $890! - 420!$

c) Show that if a polyhedron has all square faces, three meeting at each vertex, then the polyhedron must be a cube.

GOOD LUCK!!!