Max Marks: 60

Note: Answer all questions.

1. (a) If \( f(z) = u + iv \) represents the complex potential for an electric field and \( v = x^2 - y^2 + \frac{x}{x^2 + y^2} \), determine the conjugate function \( u \) and \( f(z) \) in terms of \( z \).

OR

(a') If \( f(z) = u - iv \) is an analytic function of \( z \) and \( u - v = \frac{\cos x + \sin x + e^{-x}}{2 \cos x - e^x - e^{-x}} \), find \( f(z) \) in terms of \( z \) subject to the condition \( f\left(\frac{\pi}{2}\right) = 0 \).

(b) Use Cauchy's integral theorem to evaluate the integral \( \int_{C} \frac{u}{x^2 + 1} \, dz \), where \( C \) is

(i) \( |z + i| = 2 \) 
(ii) \( |z - i| = 1 \).

(c) Find the poles of the function \( f(z) = \frac{1 - e^{2z}}{z^4} \). Determine the order of each pole and find the residue at each pole.

2. (a) Expand \( f(z) = \frac{1}{z(z-1)(z-2)} \) in a Laurent's series, if \( |z - 1| < 1 \).

(b) Use residue theorem to evaluate:

\[ \int_{C} \frac{z^2}{(z+2)(z-1)} \, dz \], where \( C \) is

(i) a square with vertices \(-1 - i, -1 + i, -3 + i, -3 - i\).
(ii) \( |z + i| = 3 \).

(c) Use contour integral to evaluate

\[ \int_{0}^{\infty} \frac{\sin x}{x} \, dx \].

3. (a) Find the directional derivative at the point \((1, -2, 1)\) on the sphere \( x^2 + y^2 + z^2 = 6 \) in the direction normal to the surface \( z = 2x^2 + y^2 - 5 \) at the point \((1, -2, 1)\).
(b) Show that the vector field given by
\[ \mathbf{F} = \left(2xy + z^2\right)\mathbf{i} + \left(2yz + x^2\right)\mathbf{j} + \left(2xz + y^2\right)\mathbf{k} \]
is irrotational and find the scalar potential \( \phi \) such that \( \mathbf{F} = \nabla \phi \).

(c) Show that \( \nabla f(r) \times \mathbf{r} = 0 \).

OR

(c') Find the constants \( a \) and \( b \) so that the surface \( ax^2 - byz = (a+2)x \) will be orthogonal to the surface \( 4x^2y + z^3 = 4 \) at the point \( (1, -1, 2) \).

4. (a) Show that \( \mathbf{F} \) is conservative if \( \mathbf{F} \) is irrotational.

(b) Verify divergence theorem for.
\[ \mathbf{F} = 4xi - 2y^2j + z^2k, \]
taken over the region bounded by the cylinder \( x^2 + y^2 = 4, z = 0, z = 3 \).

OR

(b') Verify Green's theorem for
\[ \oint_C \left( x^2 - \cos hy \right) dx + (y + \sin x) dy \]
where \( C \) is the rectangle with vertices \((0,0), (\pi,0), (\pi,1), (0,1)\).

(c) State Stoke's theorem. Use stokes theorem to evaluate
\[ \int_C \sin z\cos \mathbf{x} \cdot \mathbf{n} d\mathbf{S} \]
where \( C \) is the boundary of the rectangle \( 0 \leq x \leq \pi, 0 \leq y \leq 1, z = 3 \).

****
Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No.  
Question  
M.M.

1(a)  
Compare procedure oriented and object oriented programming paradigms. 
[05]

1(b)  
What do you understand by dynamic binding of methods? How it is implemented by a system? Also, list its advantages and disadvantages. 
[05]

1(c)  
What do you understand by the term multiple inheritance? Why access specifier 'protected' is useful in multilevel inheritance? 
[05]

2(a)  
Define the following terms in context with C++
   i. static_cast
   ii. dynamic_cast

[05]

2(b)  
State the importance of constructors and destructors in derived classes. How are they invoked at the time of object creation and destruction? Also list and explain different types of constructors available in C++. 
[05]

2(c)  
Explain with the help of suitable example exception handling in C++. 
[05]

3(a)  
What is Java Development Kit? What role does it play to write platform independent programs in Java? 
[05]

3(b)  
Explain with a suitable example, the significance of inner class in Java. 
[05]

Contd.....2.
3(c) Consider the following program:

```java
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello World!");
    }
}
```

Modify the program without modifying the main method to produce this output: "Initialize, Hello World!". Briefly outline the steps involved.

OR

3'(a) State the function of the following keywords in Java:
   i. Super
   ii. Final

3'(b) What do you understand by Interface in Java programming? How are they helpful in implementing inheritance in Java?

3'(c) Write a program in Java to draw an ellipse? Assume suitable data to draw an ellipse and explain each statement of your program.

4(a) What is the Object Modeling Techniques?

4(b) Draw the sequence diagram of login page.

4(c) What is the role of Swim lanes & Guard condition in Activity diagram?

OR

4'(a) Differentiate between the following:
   i. Generalization and Specialization
   ii. Association and Aggregation

4'(b) How to deal with concurrency in State Modeling?

4'(c) Draw the activity diagram of ATM Machine system.
2015-16
B.TECH (AUTUMN SEMESTER) EXAMINATION
COMPUTER ENGINEERING
ALGORITHMS AND DATA STRUCTURES
CO206

Maximum Marks: 60
CREDITS: 04
DURATION: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.
1(a) Define O-notation. Suppose \( P(n) = a_n + a_{n-1}n + \ldots + a_1n + a_0 \) be a polynomial of
degree \( m \). Prove that \( P(n) = O(n^m) \). [05]

1(b) Sort the individual characters of the following string in alphabetical order using
Bubble Sort algorithm.

\text{COMPUTATIONS}
Write all intermediate steps. What is the complexity of Bubble Sort algorithm?

OR

1(b') Let \( S \) be the following sorted 12 element array.
\[
S: 21 \ 31 \ 34 \ 43 \ 46 \ 56 \ 62 \ 67 \ 78 \ 83 \ 89 \ 97
\]
Apply binary search algorithm to \( S \) to search the following items: (i) 43, and (ii) 86.
Write all intermediate steps. What is the complexity of binary search algorithm?

[07]

2(a) Suppose multidimensional arrays \( A \) and \( B \) are declared using \( A(-2:2, 2:2) \) and
\( B(1:8, -5:5, -10:5) \).

(i) Find the length of each dimension and the number of elements in \( A \) and \( B \).
(ii) Consider the element \( B[3, 2, 2] \) in \( B \). Find the effective indices \( E_1, E_2, E_3 \) and
the address of the element in column major order as well as in row major
order. Assume that \( \text{Base}(B) = 400 \) and every element of the given
multidimensional arrays occupies 4 memory cells.

[06]

Concl.…..2.
2(a') Let \( n \) denote a positive integer. Suppose a function \( L \) is defined recursively as follows:

\[
L(n) = \begin{cases} 
0 & \text{if } n = 1 \\
L\left(\lfloor n/2 \rfloor + 1\right) & \text{if } n > 1 
\end{cases}
\]

(i) Find \( L(35) \).
(ii) What does this function do?

2(b) Describe a linked list. What are the merits and demerits of a linked list as compared to a linear array? With the help of an example, describe how one can represent a linked list inside the memory of a computer.

3(a) Write an algorithm for transforming an infix expression into postfix expression. Using the algorithm transform the following infix expression into its equivalent postfix expression.

\[ A - (B * C + (D/E^F) * G) / H \]

OR

3(a') Briefly describe the preorder, inorder, and postorder traversals of a binary tree. Let there be the following algebraic expression.

\[ \frac{a - (b + c)}{[(d - e)* (f - g + h)]]} \]

Draw a binary tree that represents the above expression. Write the preorder and postorder traversals of the tree. Manually convert the expression into equivalent prefix and postfix notations and verify that the preorder traversal corresponds to the prefix notation and the postorder traversal corresponds to the postfix notation.

3(b) Let there be the following list of numbers:

\[ 51 \ 28 \ 86 \ 64 \ 99 \ 34 \ 14 \ 71 \ 48 \ 21 \ 78 \ 18 \]

Sort them using Quick Sort algorithm. Write all intermediate steps. What is the complexity of Quick Sort algorithm in the worst case and in the average case?

4(a) Let \( n \) be the size of input data. Show that the lower bound on the time complexity of a comparison-based sorting algorithm is \( \Omega(n \log n) \).

Contd.....3.
4(b) Define a heap. Sort the following list in ascending order using Heap Sort algorithm.
44 33 11 55 77 90 40 60 99 22 88 66
What is the complexity of Heap Sort algorithm in the worst case and in the average case?

OR

4(b') How searching and inserting is carried out in a Binary Search Tree? Let the following ten numbers are inserted into an empty Binary Search Tree.
38 14 56 8 23 45 82 18 70 96
Draw the Binary Search Tree showing all intermediate steps. Write the inorder traversal of the resulting Binary Search Tree.

5(a) Sort the individual characters of the following string in alphabetical order using Merge Sort algorithm.
GOOD LEARNERS
What is the complexity of Merge Sort algorithm in the worst case as well as in the average case?

OR

5(a') Sort the individual characters of the following string using Insertion Sort algorithm.
SHARPMINDS
What is its complexity in the worst case and in the average case? Justify your answer.

5(b) What criteria are used to select a hash function? Describe some popular hash functions. Consider a company ABC Corporation Limited with 70 employees. All the employees are assigned a unique 4-digit employee number. Suppose the set of memory addresses consists of 100 two-digit addresses numbered from 00 to 99. Apply the hash functions to compute the addresses for the employee numbers 2345 and 4061.
2015-16
B.TECH. (AUTUMN SEMESTER) EXAMINATION
COMPUTER ENGINEERING
LOGIC THEORY & COMPUTER ORGANIZATION
CO-207

Maximum Marks: 60  Credits: 04  Duration: Three Hours

Attempt all the questions. Assume suitable data if missing.
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>M.M.</th>
</tr>
</thead>
</table>
| 1(a)  | Using Boolean Algebra, prove that:  
   (i) \( AC + BC' = AC + BC' + AB \)  
   (ii) \( A (A' + C) (A'B + C) (A' BC + C') = 0 \)  
   (iii) \( (A+B) (A' (B' + C') )' + A' (B + C) = A + B + C \) | [05] |
| 1(b)  | Simplify the following Boolean function \( F \) together with the don't-care conditions \( d \),  
   and then express the simplified function in sum-of-minterms form:  
   \( F(A,B,C,D) = \Sigma (4, 5, 7, 12, 13, 14) \)  
   \( d(A,B,C,D) = \Sigma (1,9,11,15) \) | [05] |
| 1(c)  | Simplify the following Boolean function in (a) sum of products, and (b) product of sums form  
   \( F(A,B,C,D) = \Sigma (0,1,2,5,8, 9, 10) \)  
   Draw the Logic Gate implementation of the functions in (a) and (b). | [05] |
| 2(a)  | Tabulate the truth table for an 8 x 4 ROM that implements the following Boolean functions  
   \( A(x,y,z) = \Sigma (0,3,4,6) \)  
   \( B(x,y,z) = \Sigma (0,1,4,7) \)  
   \( C(x,y,z) = \Sigma (1,5) \)  
   \( D(x,y,z) = \Sigma (0,1,3,5,7) \)  
   Considering now the ROM as a memory, specify the memory contents at addresses 1 and 4. | [05] |
| 2(b)  | Design a combinational logic circuit with three inputs \( xyz \) and three outputs \( ABC \).  
   When the binary input is 000, 001, 010, or 011, the binary output is two greater than the input. When the binary input is 100, 101, 110, or 111, the binary output is three less than the input. | [05] |

Contd.....2.
2(c) Write down/derive the expressions for 4-bit parallel/fast adder's sum and carry terms. Using the expressions for carry term derived above, show (compute) the value of final carry generated for a 4-bit parallel adder when two numbers added are A: 1111 and B: 0001 (Assuming initial carry C₁ = 0).

OR

2(c') Draw the truth table, derive logic equations, and circuit diagram for 1-bit magnitude comparator. Write the Boolean equations for 4-bit magnitude comparator.

3(a) Analyze the following circuit shown in Figure 3.1 given below, using state table approach. Consider that the T flip-flops are initially reset (output value at logic '0'). Draw the timing diagram (waveform) of output Y for minimum 6 clock cycles.

![Fig 3.1](image)

3(b) Explain the difference among truth table, a state table, a characteristic table, and an excitation table. Also, explain the difference among a Boolean equation, a state equation, a characteristic equation, and a flip-flop input equation.

3(c) A sequential circuit with two D flip-flops A and B, two inputs, x and y, and one output z is specified by the following next-state and output equations

\[
A(t+1) = x y' + x B \\
B(t+1) = x A + x B' \\
z = A
\]

(a) Derive the state table for the sequential circuit.
(b) Draw the logic diagram of the circuit.

OR

Contd.....3.
3'(a) Construct a JK Flip flop using a D flip-flop, a two-to-one line multiplexer, and an inverter.

3'(b) Draw circuit diagram of D-type positive edge triggered flip-flop through input lockout. Explain its operation.

3'(c) Using JK flip-flop design a 3-bit counter that has a repeated sequence of following six states:
000, 001, 010, 100, 101, 110.
Draw the circuit/Logic diagram of the counter.

4(a) What do you mean by an instruction code? Give at least three possible instruction formats. Differentiate between micro-operations and macro-operations [05]

4(b) Design a simple computer that is capable to execute the following instructions
   (i) Move a register R to A
   (ii) Load an Operand into A
   (iii) ADD R to A
   (iv) Move A to a memory location specified by an address ADRS.
   Write the micro-operations for Instruction Fetch Cycle, and Execution of the above four types of instructions. Thus derive the hardware specifications including control functions of this computer. Show the block diagram design.

4'(a) In a particular configuration of a computer, each memory location contains 16-bits of information. In program memory (instruction code), if 4 MSB (Most Significant Bit) contains op-code and rest contains address of memory locations, give
   (a) Number of op-codes
   (b) Number of address bits and size of memory,
   (c) Size of PC, IR, A, MAR, and MBR.

4'(b) Design an Arithmetic Logic Unit (ALU) with eight arithmetic operations and four logic operations. Draw the logic diagram for first two stages only. Show various components separately. You may use Full Adders and other Logic Gates.
Answer all the questions. Assume suitable data if missing. Notations and symbols used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
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<tbody>
<tr>
<td>1(a)</td>
<td>Explain the mechanism of current flow and hence working of tunnel diode using the energy band diagram.</td>
<td>[04]</td>
</tr>
</tbody>
</table>

1(b) A cellphone incorporates a 2GHz oscillator whose frequency is defined by the resonance frequency of an LC tank circuit. If the capacitance of this tank circuit is realized by the p-n junction with built-in potential of 0.73V and junction capacitance of 530fF with no bias applied. Calculate the change in the oscillation frequency while the reverse bias voltage goes from 0 to 2V. Assume f=2GHz with no bias applied.

OR

1(b') Sketch I_s versus V_s for the circuit shown in figure below. Assume V_s goes from 0 to 1.8V. Determine at what values of V_s the device changes its region of operation. Given V_t = 0.4V and λ = 0.

![Circuit Diagram](image)

1(c) The transistor in the circuit shown below has β=100 and exhibits a V_{BE} of 0.7V at I_c = 1mA. Design the circuit so that a current of 2mA flows through the collector and a voltage of 5V appears at the collector.

Contd....2.
2(a) Design the bias circuit shown below to obtain a dc emitter current of 1mA and to ensure a ±2V signal swing at the collector, that is, design for $V_{CE} = 2.3\text{V}$. Let $V_{CC} = 10\text{V}$ and $\beta = 100$.

\[ \text{Diagram of bias circuit} \]

2(b) NMOS and PMOS transistors shown in the figure below are matched with $k_i (W/L) = k_o (W/L) = 1 \text{mA/V}^2$ and $V_{MB} = V_{PB} = 1\text{V}$. Assuming $\lambda = 0$ for both devices, find the drain currents $i_{DS}$ and $i_{DS'}$ as well as the voltage $v_{DS}$ for $V_t = 0, 2.5\text{V}$ and $-2.5\text{V}$.

\[ \text{Diagram of NMOS and PMOS transistors} \]

2' (a) Explain, how/fix $V_G$ with source resistance biasing scheme is better than the fix $V_{GS}$ biasing?

2' (b) An enhancement NMOS transistor is connected in the bias circuit shown below with $V_G = 4\text{V}$ and $R_S = 1k\Omega$. The transistor has $V_t = 2\text{V}$ and $k_i(W/L) = 2\text{mA/V}^2$. What bias...
current results? If a transistor for which $k_v'(W/L)$ is 50% higher is used, what is the resulting percentage increase in $I_D$?

2'(c) Consider the circuit shown in figure below where $V_{BE} = 0.67V$, $\beta = 100$ and $V_A = \infty$. [04]
Calculate the operating point of $Q_1$.

3(a) For the circuit shown below, derive the expressions for $R_{in}$, $R_{out}$, $A_{ve}$ and the overall gain $G_v$. Consider $r_o$ finite. [06]

3(b) For the circuit shown below draw complete small-signal equivalent circuit. Find out $R_{in}$, $V_o/V_{SB}$ and $R_{out}$. Take $\alpha = 0.99$.

Contd......4
4(a) Define the different parasitic capacitances present in the MOSFET. What are their values in different region of operations? [04]

4(b) Derive the expression of unity current gain frequency \( f_t \) for BJT. [05]

OR

4(b') Derive the expression for the upper 3-dB frequency \( f_{tu} \) for the common source amplifier. [05]

4(c) Find \( f_r \) for a MOSFET operating at \( I_D = 100 \mu A \) and \( V_{gs} = 0.25 \text{V} \). The MOSFET has \( C_{gs} = 20 \text{fF} \) and \( C_{gd} = 5 \text{fF} \). [03]

5(a) What are the advantages given by negative feedback? [04]

5(b) What are the conditions a circuit should satisfy in order to oscillate? [03]

5(c) Draw the diagram of Colpitts oscillator. Also find frequency of oscillation. [05]

OR

5(c') Find the frequency of oscillation of FET based phase shift oscillators. [05]
2015-2016

B.TECH. AUTUMN (III SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
HIGHER MATHEMATICS - I
AM 261
Credits-04

Maximum Marks: 60                         Duration: Two Hours

Note:- Answer all the questions.

Q1.  (a) Determine the analytic function \( f(z) = u + iv \), if

\[
u + v = \frac{\sin 2x}{\cosh 2y - \cos 2x}
\]

in terms of \( z \).

(b) Using Cauchy’s integral formula, find the value of

\[
\int_C \frac{z + 4}{z^2 + 2z + 5} \, dz
\]

where \( C \) is the circle \( |z + 1 - i| = 2 \).

OR (b’) If \( t > 0 \) and \( C \) is any simple closed curve enclosing \( z = -1 \), prove that

\[
\frac{1}{2\pi i} \oint_C \frac{ze^{tx}}{(z+1)^3} \, dz = \left( t - \frac{t^2}{2} \right) e^{-t}.
\]

Q2  (a) Expand \( f(z) = 1/z(z-2) \) in a Laurent series valid for \( 0 < |z| < 2 \). Also find the poles, their order and residue at the pole \( z = -1 \) of the function

\[
f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2 + 4)}
\]

(b) Use contour integral to evaluate

\[
\int_0^\infty \frac{dx}{(x^2 + 1)^2}
\]
Q3. (a) Show that the vector field \( \vec{A} = \cos(x^2 + y^2 + z^2)(x\hat{i} + y\hat{j} + z\hat{k}) \) is irrotational and find the scalar function \( \phi \) such that \( \vec{A} = \nabla \phi \). [8]

OR (a') Verify \( \text{curl} \, \text{curl} \, \vec{A} = \nabla \text{div} \, \vec{A} - \nabla^2 \vec{A} \) for \( \vec{A} = xz^3\hat{i} - 2x^2yz\hat{j} + 2yz^4\hat{k} \).

(b) Find the directional derivative of \( \nabla \cdot (\nabla \phi) \) at the point \((3, 1, 1)\) in the direction of the normal to the surface \( xy^2z = 3x - z^2 \) at the point \((-1, 2, 3)\) where \( \phi = x^2y^2 + xy^2 - z^2 \). [7]

Q4 Answer any two parts: [7.5+7.5]

(a) Use Green’s Theorem, or otherwise, to find the work due to the force \( \vec{F} = (2x^2 - y^2)\hat{i} + (x^2 + y^2)\hat{j} \) in moving a particle along the closed path \( C \) containing the curve \( x + y = 0, x^2 + y^2 = 4, y = x \) in the first and second quadrants.

(b) Verify Stokes’s Theorem \( \int_C \vec{A} \cdot d\vec{r} = \iint_S \text{curl} \vec{A} \cdot d\vec{S} \) where \( \vec{A} = (3x - y)\hat{i} - 2yz^2\hat{j} - 2y^2z\hat{k} \), and \( C \) is the unit circle in the xy-plane bounding the hemisphere \( S \) \( z = \sqrt{16 - x^2 - y^2} \).

(c) Evaluate \( \iint_S \vec{F} \cdot d\vec{s} \), where \( \vec{F} = z^2\hat{i} + xy\hat{j} - y^2\hat{k} \) and \( S \) is the portion of the surface of the cylinder \( x^2 + y^2 = 36, \ 0 \leq z \leq 4 \) included in the first octant.