2012 – 2013
B.TECH. AUTUMN (III SEMESTER) EXAMINATION
(COMPUTER ENGINEERING)
HIGHER MATHEMATICS
(AM – 261)
Credits: 04

Maximum Marks : 60

Note: Answer all questions.
Programmable calculators are not allowed.

1. (a) Derive Cauchy-Reimann equations in polar form. Hence or otherwise deduce that:
\[ \frac{\partial^2 u}{r^2} + \frac{1}{r} \frac{\partial u}{\partial r} + \frac{1}{r^2} \frac{\partial^2 u}{\partial \theta^2} = 0 \]
for the analytic function \( f(z) = u + iv \).

(b) If \( u + v = \frac{2 \sin 2x}{e^{2y} - e^{-2y} - 2 \cos 2x} \), and \( f(z) = u + iv \) is an analytic function of \( z = x + iy \), find \( f(z) \) in terms of \( z \).

(c) If \( f(z) = \oint_C \frac{4z + z + 5}{z - z_0} \, dz \) where \( C \) is the ellipse \( \frac{x^2}{4} + \frac{y^2}{9} = 1 \), find \( f(1), f(i) \), \( f(-1) \) and \( f''(-1) \).

2. (a) Represent the function \( f(z) = \frac{4z + 3}{z(z + 2)(z - 3)} \) in Laurent’s series in

(i) \( 0 < |z| < 1 \),

(ii) \( 2 < |z| < 3 \).

(b) Using residue theorem evaluate any one of the following.

(i) \( \oint_C \frac{\sin x + \cos x}{z - 1} + \frac{z}{z - 2} \, dz \), where \( C \) is the circle \( |z| = 3 \).

(ii) \( \oint_C \frac{z + 3}{z^2 + 2z + 5} \, dz \), where \( C \) is the circle \( |z + 1 - i| = 2 \).

(c) Evaluate by contour integration \( \oint_0^{2\pi} \frac{dv}{2 + \cos \theta} \).

3. (a) A particle moves so that its position vector is given by \( \vec{r} = \cos \omega t \hat{i} + \sin \omega t \hat{j} \) where \( \omega \) is constant; show that

(i) the velocity vector of the particle is perpendicular to \( \vec{r} \).

(ii) Acceleration is directed towards the origin and has magnitude proportional to the distance from the origin.
(iii) \( \mathbf{F} \times \frac{d\mathbf{r}}{dt} \) is constant vector

(b) A vector \( \mathbf{F} \) is given by \( \mathbf{F} = (y \sin z - \sin x) \mathbf{i} + (x \sin z + 2yz) \mathbf{j} + (xy \cos z + y^2) \mathbf{k} \). Prove that it is irrotational and hence find its scalar potential function.

(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 \((1, -1, 2)\).

OR

(c') Find the directional derivative of \( \phi = x^2 - 2y^2 + 4z^2 \) at the point \( P(1, 1, -1) \) in the direction of \( 2\mathbf{i} + \mathbf{j} - \mathbf{k} \). Also find the maximum value of the directional derivative at \( P \).

4. (a) Evaluate \( \int \int_S \mathbf{F} \cdot n \, ds \), where \( \mathbf{F} = 4x \mathbf{i} - 2y^2 \mathbf{j} + z^2 \mathbf{k} \) and \( S \) is the curved surface of the cylinder \( x^2 + y^2 = 4, \ z = 0, \ z = 3 \).

(b) Apply Green's theorem to evaluate \( \int \left[ (xy^2 - 2xy) \, dx + (x^2y + 3y) \, dy \right] \) around the boundary \( C \) of the region enclosed by \( y^2 = 8x \) and \( x = 2 \).

(c) Use Stokes's theorem to prove that \( \int_C \left[ (x^2 - y^2) \mathbf{i} + 2xyz \right] \cdot d\mathbf{r} = 2ab^2 \), where \( C \) is the boundary of the rectangle bounded by the lines \( x = 0, \ x = a, \ y = 0, \ y = b \).
Maximum Marks: 60
Duration: Three Hours

1. (a) Give brief answers of the following:
   i. What is a data structure?
   ii. What does Abstract Data Type (ADT) mean?
   iii. In which data structure, elements can be added or removed at either end, but not in the middle?
   iv. Parentheses are never needed in prefix or postfix expressions. Why?
   v. What is the maximum total number of nodes in a tree that has N levels (height)?
      Assume root as level zero.
   vi. What does the term complete means when applied to binary tree?

(b) List the strengths and weaknesses (in terms of insert, delete, access/search operations) of the following data structures in a tabular form:

<table>
<thead>
<tr>
<th>Data Structures</th>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Array</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ordered Array</td>
<td></td>
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<tr>
<td>Stack</td>
<td></td>
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<tr>
<td>Queue</td>
<td></td>
<td></td>
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<tr>
<td>Linked List</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binary Tree</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Answer any two parts:

   (e) Define Big-O, Big-Omega, Big-Theta, and Little Oh Notations in terms of inequality relationship between functions f(n), g(n) and other conditions. Compute the time complexity of the following relations. Find values of c and n₀ also for each case.
   i. T(n) = 4n - 12
   ii. T(n) = 13n² - 7

(b) Explain Polish Notation, and Reverse Polish Notation. Write algorithm to transform infix expressions into postfix expressions. Consider the following arithmetic infix expression Q:

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

   Using algorithm, transform Q into its equivalent postfix expression P, clearly showing scanned symbols, stack values, and expressions in tabular form.

(c) Explain Quick sort algorithm through an example and derive its run time complexity.

3. Answer any two parts:

   (a) What do you mean by searching? Explain Linear Search and Binary Search. Write algorithm for binary search in an array DATA which is sorted in increasing numerical order, or equivalently alphabetically. Find the complexity of binary search.

(b) Describe Circular Queue. How do we test the conditions for queue empty and queue full? Write algorithms for addition and deletion of elements in a circular queue. Explain priority Queue. Show one way list representation of Priority Queue.
(c) Explain Row-major and Column-major representation for storage of data in memory. Suppose each student in a class of 60 students is given 4 tests. Assuming the students are numbered from 1 to 60, the test scores can be assigned to a 60x4 matrix array SCORE. Assume SCORE[K,L] contains the Kth student's score on Lth test. Suppose Base(SCORE) = 200 and there are w = 4 words per memory cell. Further suppose that the programming language stores two-dimensional arrays using row-major. Find out the address of SCORE[12,3] and SCORE[15,4].

4 Answer any two parts

(a) What is overflow and underflow in linked list data structure? Assuming that a linked list called LIST is stored in memory; write an algorithm which deletes the last node from the LIST. What is two-way or doubly linked list?

(b) Following two traversals of 9 nodes are given. Can a binary tree be constructed using these? If yes, construct the binary tree from the following two traversals

In-order : E, A, C, K, F, H, D, B, G
Pre-order : F, A, E, K, C, D, H, G, B

(c) Explain Preorder, Postorder, and Inorder Traversal of a binary tree. What type of binary tree traversal can be used to solve the following expression? Give a binary tree representation of the following arithmetic expression:

\[
\frac{(3+1) \times 3}{(9-5)+2} - (3 \times (7-4) + 6)
\]

5 Answer any two parts

(a) Describe Binary Search Tree by listing the properties. Through examples explain insertion and deletion operations in a binary search tree.

(b) Explain Heap data structure. Create a heap for the input sequence with key values:

\[5, 9, 4, 2, 1, 6\]

(c) Describe with the help of examples, directed graph, undirected graph and weighted graph. Explain the insertion and deletion operation for array-based representation of graph.
Maximum Marks: 60

Answer all the questions.

1. (a) Add \((ACE1)_{16}\) and \((16 B7D)_{16}\). 
   \(5\times3\)

(b) Subtract \((3 A 8)_{16}\) from \((1273)_{16}\).

(c) Convert decimal number 225.25 to binary, octal and hexadecimal numbers.

OR

1' (a) Simplify the following Boolean function using tabulation method to minimum number of terms:
   \[ F = \Sigma (0, 1, 2, 8, 10, 11, 14, 15) \]
   \(5\times3\)

(b) Simplify the following Boolean function in (i) SOP form and (ii) POS form:
   \[ F(A, B, C, D) = \Sigma (0, 1, 2, 5, 8, 9, 10) \]

(c) Express the Boolean function \(F = \overline{A} + \overline{B} C\) in the sum of minterm.

2. (a) Design a combinational circuit using a ROM. The circuit accepts a 2-bit number and generates an output binary number equal to the cube of input number. 
   \(5\times3\)

(b) Show how a full adder can be converted to a full subtractor with the addition of one inverter circuit. 

(c) Draw the basic logic circuit and explain the working of a 4-input multiplexer.

OR

2' (a) Draw a logic diagram using ONLY TWO-INPUT NAND GATES to implement the following expression:
   \[ F = (A \overline{B} + \overline{A} \overline{B}) (C \overline{D} + \overline{C} \overline{D}) \]
   \(5\times3\)

(b) Design a circuit that comprises two 4-bit numbers, A and B to check if they are equal. The circuit has one output 'X' so that \(X = 1\) if \(A = B\) and \(X = 0\) if \(A \neq B\).

(c) A combinational circuit is defined by the three functions:
   \[ F_1 = \overline{X} Y \overline{Z} + X Z, \quad F_2 = X \overline{Y} \overline{Z} + \overline{X} Y \]
   \[ F_3 = \overline{X} Y Z + X Y \]

   Design the circuit with a decoder and external gates.

......2.
3. (a) How serial transfer of information from one register to another register is done with shift register? Explain with the help of timing diagram and block diagram.

(b) Discuss characteristic table and excitation table of various flip-flops.

(c) Construct of 4-bit Johnson's counter and write its activity table.

4. (a) Design an adder/subtractor circuit with one selection variable 'S' and two inputs 'A' and 'B'. When S=0, the circuit performs A + B. When S=1, the circuit performs A - B by taking the 2's complement of B.

(b) Differentiate between Hardwired and Micro program control unit. List advantages and disadvantages of each method.

(c) What is an ALU? Give the typical organization of an ALU and explain its operation.
1. (a) Differentiate between the following:
   (i) Interpreter and Compiler
   (ii) Method overloading and **Overriding** a method

(b) Abstraction and Encapsulation are complementary to each other. Justify.  
   OR

(b') Function overloading is compile time polymorphism! Justify.  

(c) Differentiate between private, public and protected access modifiers. Also explain their meaning when a derived class inherits from a base class using public, protected and private keywords. Give examples  
   OR

(c') Explain function and operator overloading. What are the rules for overloading and operator? List the operators that cannot be overloaded.

2. (a) When does an exception class require data members? Give an example which throws an exception with an argument?  

(b) Give the general syntax of function templates and explain their use.  

(c) Define a class DATE, use overloaded + operator to add two dates and display the result. Assume non-leap year dates.  
   OR

2.1 (a) What is a copy constructor? Explain it with the help of a suitable example. When are copy constructors called?  

(b) Write a function template for finding the minimum value contained in an array.  

(c) What are the ambiguities that arise in multiple and diamond shaped inheritance? How can they be removed?
3. (a) Explain the working of JVM in the light of working of its components. (5)

(b) Write a Java class `Point` to represent a two-dimensional point (x, y). Extend it to a class `Circle` with its centre as the point and an additional radius member and extend further to a class `Cylinder` with additional height member.

(c) Discuss the Java error handling mechanism? What is the difference between 'unchecked exceptions' and 'checked exceptions'? OR

(c') Describe the importance of bytecode to get platform independence of Java program.

4. (a) Draw the Sequence Diagram for an ATM System. (5)

(b) List and explain the types of relationships used in object-oriented modelling along with their notation.

(c) Prepare a class diagram from the object diagram in the figure below. Explain your multiplicity decisions. Each point has an x coordinate and a y coordinate. What is the smallest number of points required to construct a polygon? Does it make a difference whether or not a point may be shared between polygons? Your answer should address the fact that the points are ordered.

![Object Diagram for a polygon that happens to be a square](image-url)
Maximum Marks: 60  

1. Attempt all questions  
2. Make appropriate assumptions if required  
3. Symbols and abbreviations have their usual meanings.

Q1. (a) Explain how the tunnel diode is used in the design of a negative resistance oscillator.

(b) For the circuit shown in Fig. 1, with $V_{CC} = 15V$, $V_{BE} = -1.5V$, $V_T = 25mV$, the BJT is specified to have $\beta = 100$ 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 collector.

Q2. (a) Prove that the stability factor $S$ for the self-biased circuit shown in Fig. 2 is:

$$S = \frac{1 + R_E}{1 + R_E + R_g}$$

(b) Explain the term "channel length modulation" in MOSFET. Derive the expression for $I_D$ (in presence of channel length modulation).

OR

(b') For the circuit shown in Fig. 2 (self-bias) the transistor may have any value of $\beta$ between 36 and 90 at a temperature of 25°C and leakage current $I_{CO}$ has negligible effect on $I_C$ at room temperature. Find $R_E$, $R_A$ subject to the following specifications: $R_C = 4K\Omega$, $V_{CC} = 20V$ the nominal bias point is to be at $V_{CE} = 10V$, $I_C = 2mA$, and $I_C$ should be in the range of 1.75mA to 2.25mA as $\beta$ varies from 36 to 90.

Q3. (a) For the circuit shown in Fig. 3 determine the following parameters

(i) Collector current and the transconductance  
(ii) Base current and the input resistance at the base

(b) Draw the small signal equivalent model for a common-source amplifier with a source resistance. Derive the expression for voltage gain $A_v$ and overall voltage gain $G_o$.

OR

(b') Draw the small signal equivalent circuit of common emitter amplifier with $V_{CE} = V_{BE} = 10V$, $I_C = I_B = 1mA$. $R_A = 100K\Omega$, $R_C = 8K\Omega$, $V_A = 100V$ and $\beta = 100$. Evaluate $R_{in}$, $A_v$ (without and with $R_A$ taken into account). Find $A_v$
when $R_L = 5K\Omega$.

Q4. Draw the high frequency equivalent circuit of a common-source amplifier and determine the input capacitance $C_i$ and the upper $3\text{dB}$ frequency $f_T$. (12)

OR

Q4'. Draw the high-frequency hybrid-$\pi$ model of the BJT. Drive the expression for common emitter short-circuit current gain as a function of frequency in terms of hybrid-$\pi$ components. (12)

Q5. Define piezoelectric effect of crystal oscillator. Determine its series resonance and parallel resonance frequencies. (12)

OR

Q5'. Draw the ideal structure and determine the feedback gain, input and output impedance in the following case:

(i) Voltage series feedback
(ii) Current series feedback

*ALL FIGURES ARE SHOWN ON THE NEXT PAGE*
2012-2013
B.TECH. AUTUMN (II SEMESTER) EXAMINATION
(ELECTRONICS / COMPUTER ENGINEERING)
COMMUNICATION SKILLS
(III-U-202)
Credits: 04

Maximum Marks: 40

Duration: Three Hours.

Answer all questions.

1. You are the Sales Manager of a firm supplying educational technologies to academic institutions. Draft a persuasive letter to be sent to the Principals of Colleges to promote the concept of ‘Smart Classroom’. 08

OR

On behalf of the Principal of your College, write a letter of enquiry to the ‘Software Solutions’, Nehru Place, New Delhi, seeking the details of educational softwares available for Engineering Colleges specially for the labs, classrooms and language lab.

2. Write a job application and create a resume in response to the following advertisement:

![K L University Advertisement](image-url)

K L University

Wanted Managers and Faculty Members.

Applications with full particulars are invited from eligible candidates in the following disciplines to meet the above vacancies within fifteen days of receipt of this advertisement.

Qualification: Relevant P. G. Degree with minimum 65% Ph.D and NET/SLET are desirable. Relevant work experience preferred.

Experience:

Age:

Remuneration:

Reservations:

Location:

Candidates should be willing to travel and be ready to work as per the demands of work.

...2.
3. Write short notes on any one of the following and give appropriate examples.
   (a) Memo
   (b) Press Notice.

4. Read the following passage and (a) Make notes in an appropriate format
   (b) Write an abstract of the passage.

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As many as 1,075 satellites will be built worldwide over the next 10 years and $188 billion revenue will be generated from their manufacture and launch, according to Euroconsult, the Paris-based consulting and analysis firm specializing in the global space industry.

In comparison, 890 satellites were made and launched in the last 10 years.

Governments will order over 66 per cent of these or nearly 710 spacecraft mostly for earth observation purposes, it says. They will also contrib-ute 66 per cent of the decade’s revenues from building and launching them.

Revenues from the manufacture and launch of these satellites for 2012-21 will see 26 per cent growth over that from the last 10 years, says Euroconsult’s latest and the 35th annual research report, Satellites to be Built & Launched by 2021: World Market Survey.

The earth observation category during the period is expected to number around 260, said the 88-year-old Euroconsult, which focuses on space applications, communications, and digital broadcasting.

"Over the next six years, an average of 120 satellites a year will be put into orbit, it estimates. "The launch tempo will develop at the end of the period as government and commercial satellite constellations complete their deployment." (The cyclical pattern is said to be typical of the world satellite industry.)

The six established space powers – the U.S., Russia, Europe, Japan, China and India – are forecast to continue dominating 86 per cent of future government satellite demand. The rest will be in spate of a new set of space-faring countries emerging.

In the growth year of 2011, the world saw 100 spacecraft launched, an activity unknown since the late 1990s," the report says.

"No kind of peak was just seen when mobile personal communications were taking off and the first separation of the two commercial satellite constellations were put into orbit. These new players are expected to account for 110 satellites of different sizes and uses. According to Rachel Villain, Director for Space at Euroconsult and editor of the research report, "Governments in established space countries continue to drive innovation for satellite systems with benefits for their local industries even if systems’ replacements are more carefully assessed in the countries where cost limits become stricter.

During the decade, she adds, the commercial space industry would be launching almost 76 per cent of its new orders as replacements of ageing spacecraft for communication and broadcasting purposes.

Some 50 companies are engaged in procuring and operating such satellites in the GEO (geostationary earth orbit)."

Philipp Kneip estimates that numerous government-backed operators [are] acquiring their first satellites to manage satellite bandwidth on their own.

"Among them are new country players such as Turkmenistan, Laos and Belarus which, together, account for 15% of upcoming satellites."
5. Reproduce the script of a job interview you attended for the post of Junior Software Analyst at HCL, Noida.

OR

Generate a group discussion among at least four participants on one of the following topics:
(a) FDI will boost Indian economy in the retail sector.
(b) There should be a retirement age for the politicians.