2017-2018

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) Show that the function $u(r, \theta) = \frac{1}{r^2} \cos 2\theta$ is harmonic. Find the corresponding conjugate harmonic function $v(r, \theta)$ and the analytic function $f(z) = u(r, \theta) + iv(r, \theta)$ in terms of $z$.

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

$$\int_C \frac{\cos \pi z^2}{z^2 - 3z + 2} \, dz$$

where $C$ is the circle $|z| = 3$ described in the positive sense.

OR (b') Evaluate $\int_C f(z) \, dz$ where $f(z) = z/\bar{z}$ and $C$ is the boundary of the upper half annulus region enclosed by $x^2 + y^2 = 4$ and $x^2 + y^2 = 9$. The orientation of $C$ is in anticlockwise.

Q2 (a) (i) Find the residue at $z = 0$ of the function $f(z) = \frac{1 + e^z}{\sin z + z \cos z}$.

(ii) Evaluate, by using Cauchy’s residue theorem, the integral

$$\int_C \frac{e^z - 1}{z(z-1)(z-i)^2} \, dz$$

where $C$ is the circle $|z| = 2$ described in the positive sense.

OR (a') (i) Evaluate $\int_C \tan z \, dz$ where $C$ is the curve $|z| = 2$.

(ii) Obtain the Laurent’s series of the function $f(z) = \frac{1}{z(1-z)}$ in the region $1 < |z+1| < 2$. contd...
(b) Use contour integral to evaluate
\[ \int_{\infty}^{\infty} \frac{x^2}{(x^2+1)(x^2+4)} \, dx \]

Q3. (a) Find the constants \(a, b, c\) so that the vector field
\[ \vec{A} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x - cy + 2z)\hat{k} \]
is irrotational. Use these values of \(a, b, c\) to find the scalar function \(\phi\) such that \(\vec{A} = \text{grad} \phi\).

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

(b) Find the directional derivative of \(\phi = 3x^2y - y^3z^2\) at the point \((1, -2, -1)\) in the direction along the tangent to the curve \(x = t, y = t^2, z = t^3\) at the point \((1, 1, 1)\).

Q4 (a) Evaluate \(\int_{C} \vec{A} \cdot d\vec{r}\) and \(\int_{C} \vec{A} \times d\vec{r}\) where \(\vec{A}\) is the vector field given by \(\vec{A} = (x + y)\hat{i} - x^2\hat{j} + (y + z)\hat{k}\) and \(C\) is the curve \(x^2 = 4y, z = x, \ 0 \leq x \leq 2\).

OR (a') Verify Green's Theorem for \(\int_{C} 3x^2y \, dx - 2xy^2 \, dy\) where \(C\) is the boundary of the region \(x^2 + y^2 \leq 16, \ x \geq 0, y \geq 0\). The orientation of \(C\) is in anticlockwise.

(b) Verify divergence theorem for \(\vec{F} = x^2\hat{i} + x^2y\hat{j} + x^2z\hat{k}\) where \(S\) is the part of the sphere \(x^2 + y^2 + z^2 = 4\), above the \(xy\)-plane bounded by \(xy\)-plane.
2017-18  
B.TECH. (AUTUMN SEMESTER) EXAMINATION  
COMPUTER ENGINEERING  
OBJECT ORIENTED PROGRAMMING  
CO-203  

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours  

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Discuss about the key concepts of object oriented programming.</td>
<td>[7.5]</td>
</tr>
<tr>
<td>1(b)</td>
<td>i. What is class and how does it accomplish data hiding?</td>
<td>[7.5]</td>
</tr>
<tr>
<td></td>
<td>ii. What is an abstract class and why do we need abstract classes? Write code for a sample abstract class in C++ and java.</td>
<td></td>
</tr>
<tr>
<td>2(a)</td>
<td>Demonstrate the four uses of the scope resolution operator with C++ programmes.</td>
<td>[7.5]</td>
</tr>
<tr>
<td>2(b)</td>
<td>What is generic programming? How is it implemented in C++?</td>
<td>[7.5]</td>
</tr>
</tbody>
</table>

**OR**

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<tr>
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<tbody>
<tr>
<td>2'(a)</td>
<td>What is ‘this’ pointer and what are the applications of ‘this’ pointer?</td>
<td>[7.5]</td>
</tr>
<tr>
<td>2'(b)</td>
<td>Write a programme in C++ to handle out of range problem using exception handling.</td>
<td>[7.5]</td>
</tr>
<tr>
<td>3(a)</td>
<td>i. What are the different forms of inheritance in java? Give examples with syntax for each.</td>
<td>[5+2.5]</td>
</tr>
<tr>
<td></td>
<td>ii. What are reference variable? Give syntax for it.</td>
<td></td>
</tr>
<tr>
<td>3(b)</td>
<td>Why an interface cannot implement another interface? What is the way to implement it? Provide an example to implement interface.</td>
<td>[7.5]</td>
</tr>
</tbody>
</table>

**OR**

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<tr>
<td>3'(a)</td>
<td>i. What is polymorphism? Differentiate between static and dynamic polymorphism with examples.</td>
<td>[5+2.5]</td>
</tr>
<tr>
<td></td>
<td>ii. What is static member function and what are the properties of static member functions?</td>
<td></td>
</tr>
</tbody>
</table>

*contd...*
3(b) Define applets in Java and discuss their life cycle. Write an example applet program and also explain how an applet is invoked.

4(a) i. Describe the meaning of "<extend>" and "<include>" in an UML use-case diagram.

   ii. How are specialisation and generalisation relationships defined, and how they are represented in an UML class diagram?

   iii. How are aggregation and composition relationships represented in an UML class diagram?

4(b) Prepare a class diagram from the given object diagram (Given in Figure 1):

![Class Diagram]

Figure 1
Q.No. | Question | M.M.
--- | --- | ---
1(a) | What are the properties of a good algorithm? What are the fundamental parameters of algorithmic efficiency? Discuss in detail. | [08]
1(b) | Define Big-Oh, Big-Omega and Big-Theta notations giving suitable examples. | [07]

OR

1(b') | Write an algorithm to find the number of bits in the binary representation of an integer 'n'. What is the time complexity of your algorithm? | [07]

2(a) | Sort the following list of numbers in ascending order using Quicksort algorithm: 41 33 10 54 75 91 40 61 90 80 25 67. Show all the steps involved. Discuss the time complexity of Quicksort algorithm. | [08]

2(b) | Describe an algorithm for Insertion sort and sort the following numbers: 66 55 76 43 57 89 73 19. Discuss the time complexity of Insertion sort. | [07]

OR

2(b') | Describe Binary Search Algorithm. Which algorithmic technique is used in Binary Search Algorithm? Let A be a sorted array of 10 numbers as given below: 11 22 35 45 49 53 58 67 73 91. Apply Binary Search on A to search the following numbers: a) 45 b) 90. Write all intermediate steps. | [07]
3(a) Show how a queue can be implemented using a linear linked list. Write algorithms for Insert and Remove operations.

3(b) Convert the following infix expression to postfix expression using stack. Show all the steps involved.

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

OR

3(b') Write an algorithm to evaluate a postfix expression using stack. Show all the steps involved in the evaluation of the following postfix expression.

\[3 5 7 4 - 2 S * +\]

4(a) The Inorder and Postorder traversal of a binary tree is given below:

Inorder: "D B F E A G C L J H K"
Postorder: "D F E B G L J K H C A"

Construct the binary tree from the above information. Also write the Preorder traversal of the tree.

4(b) Sort the following list of numbers using Heapsort:

25 57 48 37 12 92 86 33

Show all the steps involved. Also discuss the time complexity of Heapsort.

OR

4(b') Explain the following terms with suitable examples:

a) Completely connected graph.

b) Strongly connected graph.
2017-18
B.TECH. (AUTUMN SEMESTER) EXAMINATION
COMPUTER ENGINEERING
LOGIC THEORY AND COMPUTER ORGANIZATION
CO-207

Maximum Marks: 60  Credits: 04  Duration: Two Hours

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

Q.No.  Question  M.M.

1(a)  Using no more than two NOR gates, implement the Boolean Function \( F(a,b,c,d) = \overline{a} \overline{b} \overline{c} + a \overline{b} \overline{d} + \overline{a} \overline{b} c \overline{d} \) with the don't care condition 
\( d = a b c + a \overline{b} d \). Assume that both the normal and compliment inputs are already available.  [07]

1(b)  By means of truth tables, demonstrate the validity of De Morgan’s Theorem for three Boolean variables.  [08]

OR

1' Using the Tabulation Method, simplify in POS form the Boolean Function \( F(v,w,x,y,z) = v x z + \overline{v} x \overline{y} z + \overline{v} x y z \) with the don't care condition 
\( d = y z + \overline{v} y z + v y z \).  [15]

2(a) Sketch and explain the Block Diagram of a BDC Adder.  [07]

2(b) Design a 8:1 Multiplexer using 2:1 Multiplexers only.  [08]

OR

2(b') Design an 8 to 3 Priority Encoder.  [08]

cont'd... 2.
3(a) Using T Flip-Flops, design a counter that counts the binary sequence 3,0,4,2,1,6,5,7 and repeat.

3(b) Design a 4-bit binary counter with parallel load having the following function table:

<table>
<thead>
<tr>
<th>Clear</th>
<th>CP</th>
<th>Load</th>
<th>Count</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Clear to 0</td>
</tr>
<tr>
<td>1</td>
<td>X</td>
<td>0</td>
<td>0</td>
<td>No Change</td>
</tr>
<tr>
<td>1</td>
<td>↑</td>
<td>1</td>
<td>X</td>
<td>Load inputs</td>
</tr>
<tr>
<td>1</td>
<td>↑</td>
<td>0</td>
<td>1</td>
<td>Count next binary state</td>
</tr>
</tbody>
</table>

4 Using Full Adders, design a 2-bit Arithmetic Logic Unit (ALU).
Question 1. [06 x 2 = 12 Marks]

i. The collector voltage of a bipolar transistor varies from 1 V to 3 V while the base-emitter voltage remains constant. What Early voltage is necessary to ensure that the collector current changes by less than 5%? (CO1)

ii. An NMOS device operating with a small drain-source voltage serves as a resistor. If the supply voltage is 1.8 V, what is the minimum on-resistance that can be achieved with W/L = 20? Assume, $V_{TH} = 0.4 \text{ V}$ and $\mu_C = 200 \ \mu\text{A/V}^2$. (CO1)

OR

ii. We wish to use NMOS transistor as a variable resistor with $R_{on} = 500 \ \Omega$ at $V_{GS} = 1 \text{ V}$ and $R_{on} = 400 \ \Omega$ at $V_{GS} = 1.5 \text{ V}$. Explain why this is not possible. (CO1)

Question 2. [06 x 2=12 Marks]

i. The circuit of Fig. 1 must be designed for an input impedance of greater than 10 kΩ and a $g_m$ of at least 1/(260 Ω). If $\beta = 100$, $I_S = 2 \times 10^{-17} \text{ A}$, and $V_A = \infty$, determine the minimum allowable values of $R_1$ and $R_2$. (CO3)

![Fig. 1](image)

ii. The amplifier circuit of Fig. 2 is designed with $W/L = 20/0.18$, $\lambda = 0$, and $I_D = 0.25 \text{ mA}$. Assume, $V_{TH} = 0.4 \text{ V}$ and $\mu_C = 200 \ \mu\text{A/V}^2$. (CO2)

a) Compute the required gate bias voltage.

b) With such a gate voltage, how much can $W/L$ be increased while $M_1$ remains in saturation? What is the maximum voltage gain that can be achieved as $W/L$ increases?

Contd..... 2.
Question 3. [6+6=12 Marks]

i. The CS stage depicted in Fig. 3 must achieve a voltage gain of 15 at a bias current of 0.5 mA. If \( \lambda_1 = 0.15 \text{ V}^{-1} \) and \( \lambda_2 = 0.05 \text{ V}^{-1} \), determine the required value of \((W/L)_2\). Assume, \( \mu_n C_{ox} = 200 \mu\text{A/V}^2 \) and \( \mu_p C_{ox} = 100 \mu\text{A/V}^2 \).

\[ V_{DD} = 1.8 \text{ V} \]

\[ V_{in} \rightarrow M_2 \rightarrow V_{out} \]

\[ V_b \rightarrow M_1 \]

Fig. 3

\[ V_{DD} \]

\[ C_F \rightarrow M_1 \rightarrow C_{in} \]

Fig. 4

ii. Draw the small-signal circuit models for an npn transistor
   a) Neglecting the Early effect.
   b) Including the Early effect.

OR

ii'. Draw the small-signal circuit models for the n-channel MOSFET
   a) Neglecting the effect of the channel length modulation.
   b) Including the effect of the channel length modulation.

Question 4. [06 x 2 =12 Marks]

i. Using Miller’s theorem, estimate the input capacitance of the circuit depicted in Fig. 4. Assume \( \lambda > 0 \) but neglect other capacitances. What happens to the input capacitance if \( \lambda \rightarrow 0 \) ?

ii. For an n-channel MOSFET with \( t_{ox} = 10 \text{ nm} \), \( L = 1.0 \mu\text{m} \), \( W = 10 \mu\text{m} \), \( L_{ov} = 0.05 \mu\text{m} \), \( C_{sbo} = C_{dbo} = 10 \times 10^{-15} \text{ F} \), junction built-in voltage \( V_b = 0.6 \text{ V} \), \( V_{SB} = 1 \text{ V} \), and \( V_{DS} = 2 \text{ V} \), calculate the following capacitances (in fF) when the transistor is operating in saturation: \( C_{gd} \), \( C_{gs} \) and \( C_{sb} \). (Assume \( \varepsilon_{ox} = 3.45 \times 10^{-11} \text{ F/m} \)).

OR

ii'. Derive the expression for the unity-gain frequency \( f_T \), for the high-frequency operation of the MOSFET as an amplifier. (The unity-gain frequency is defined as the frequency at which the short-circuit current gain of the common-source configuration becomes unity)
Question 5. [6 x 2=12 Marks]

i. Figure 5 shows the tuned circuit used in a Hartley oscillator, with \( L_1 = 1 \ \mu\text{H} \), \( L_2 = 0.2 \ \mu\text{H} \), and \( C = 1000 \ \text{pF} \). (a) What is its frequency of oscillation? (b) What is the feedback factor \( \beta \)? (c) For the oscillator to start, what is the minimum value of gain \( A \)? \( A \) is the gain magnitude of the amplifier without feedback.

\[ \text{From the collector} \quad \boxed{L_1} \quad \boxed{C} \quad \boxed{L_2} \quad \text{To the base} \]

Fig. 5

\[ \quad \text{Fig. 6} \]

\[ \frac{dI_C}{dV_{BE}} = \frac{-\beta/R_E}{R_B/R_E + (1 + \beta)} \quad \text{where,} \ R_B = R_1/R_2 \]

ii. For the self-bias circuit shown in Fig. 6, show that

\[ \frac{dI_C}{dV_{BE}} = \frac{-\beta/R_E}{R_B/R_E + (1 + \beta)} \]

OR

ii. When negative voltage feedback is applied to an amplifier of gain 100, the overall gain falls to 50.

a. Calculate the fraction of the output voltage feedback.

b. If this fraction is maintained, calculate the value of the amplifier gain required if the overall stage gain is to be 75.