Full Marks: 35   Time: 2 hours

Attempt question 1 and any <u>three</u> from the rest
All answers must be written on a single answer-script
All parts of the same question must be answered together

1. (a) Convert the decimal number 83.625 into binary.   [4]
(b) The following program takes two integers x and y as input and computes x^y. However, there are some errors in the program. Identify the errors and write the program correctly.   [4]

```
#include <stdio.h>
int main( ) {
        int x, y, p, j ;
        scanf ( "Enter two numbers: %d %d", x, y );
        for ( j = 0; j < x; j++ ) {         p = p * y;       }
        printf ( "Result = %d", p );
        return 0;
}
```

(c) Write a C function that takes two integer variables as argument, and swaps (interchanges) the values of the two variables. Write a main( ) function that uses this function to swap two variables. [3]
(d) Write a <u>recursive</u> function to compute and return the factorial of an integer. Explain the working of the function when the function is called with the argument 5.   [3]

2. (a) Using 4-bit 1's complement or 2's complement binary arithmetic, (i) add the decimal numbers 2 and 3, (ii) subtract the decimal number 5 from the decimal number 2.
(b) Draw a logic gate circuit to implement the function $F = (X'.Y.Z') . (X + Y' + Z)$ where X' denotes the complement of X.   [4 + 3]

3. (a) Write a C function *int range (int arr [ ], int num)* that takes an integer array and its length as arguments, and returns the difference between the maximum element and the minimum element in the array. For instance, range ([2, 4, 7, 1, 3], 5) should return $7 - 1 = 6$.
(b) State the truth table and logic gate circuit for a half adder (which adds two bits).   [4 + 3]

4. (a) Write a function *int str_rev_cmp(char s[ ], char t[ ])* that takes two strings as arguments, and compares the first string s with the reverse of the second string t. The function should return 0 if s and reverse of t are the same, and non-zero otherwise. For instance, *str_rev_cmp("besu", "useb")* should return 0 while *str_rev_cmp("besu", "besu")* should return non-zero.
(b) Distinguish between local and global variables in a C program.   [4 + 3]

5. Write a C program that takes as input a 6 x 6 matrix and stores the matrix in a two-dimensional array. The program then checks whether the matrix is symmetric. Note that a matrix A is symmetric only if $A_{jk} = A_{kj}$ for all j and k, where $j \neq k$.   [7]

6. Define a C structure named *comp* to store a complex number with real and imaginary parts. Write the following C functions: (i) a function that takes a complex number (a variable of type *struct comp*) as argument, and returns the magnitude of the complex number, (ii) a function that takes two complex numbers A and B as arguments, and returns another complex number C which is equal to the product of A and B.   [7]