

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 2nd Term Examination, 2017
Department of Computer Science and Engineering
CHEM 1207
Chemistry

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is miller indices? Give one example of it in case of simple cubic unit cell. Draw 111, 110 and 100 planes for simple cubic unit cell. (11)
b) Explain about different types of crystal symmetry. (09)
c) Explain about hexagonal closed packed structure of metal. (07)
d) Draw face-centered and body-centered cubic lattices and explain them in brief. (08)
2. a) "No perfect crystal exists in reality" – explain. (07)
b) What do you mean by defects in solid? Explain about Schottky and Frenkel defects. (13)
c) What is color center? How does it arise in crystalline solid? (07)
d) "SiCl₄ is very reactive but CCl₄ is inert" – explain. (08)
3. a) State the Kohlrausch's law. How can you determine the Λ_0 of weak electrolytes using this law? (10)
b) What is equivalent conductance? Show graphically the variation of equivalent conductance against concentration for NaCl and CH₃COOH. Explain the nature of these curves. (10)
c) Calculate the equivalent conductance of $\frac{N}{10}$ strong electrolyte solution. Given that cell constant = 1.10 cm⁻¹ and $R = 2.43 \times 10^3$ ohms. (05)
d) "Oxygen molecule is paramagnetic" – explain with the help of Molecular Orbital theory. (10)
4. a) What do you mean by electromotive force (EMF)? Derive Nernst equation for determining EMF. (11)
b) Draw the two dimensional schematic diagram of Lithium ion battery. Mention each terms. Discuss the charging and discharging process with chemical reaction. (12)
c) What is transport number? Describe one method of determining transport number. (12)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Explain about quantization of energy. Relate the Plank's theory to explain it. (08)
b) Describe the instrumentation of a spectrophotometer. (12)
c) Explain about the function of monochromator and detector. (08)
d) Explain the emission band spectra. (07)
6. a) State and explain the laws of photochemistry. (09)
b) Discuss the difference between photochemical reaction and thermal reaction. (08)
c) What is quantum yield? How would you explain very high and very low quantum yield of some photochemical reactions? (12)
d) A compound absorbs 3.0×10^{18} quanta of light per second on irradiation for 20 minutes. 3.0×10^{-3} mol reactant was found to have reacted. Calculate the quantum yield of the reaction. (06)
7. a) Discuss the mechanism for the polymerisation of propylene in the presence of H₂SO₄ catalyst. (08)
b) Distinguish between thermosetting polymer and thermoplastic polymer. (07)
c) What is conducting polymer? Write down the advantages of conducting polymer over traditional polymer. (10)
d) Write short notes on the preparation, properties and uses of Nylon 6,6. (10)
8. a) What do you mean by high polymer and co-polymerization? (07)
b) Describe one chemical synthesis method of conducting polymer. (10)
c) Discuss the structure and properties of polymer. (10)
d) Why should cross-linking as it occurs in vulcanized rubber and other polymers increase the hardness and strength of the substance? (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2017
 Department of Computer Science and Engineering
 CSE 1201
 Structured Programming

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is cyclic property of data type in C language? Determine and explain the output of the following C program: (13)

```
int main(){
    unsigned char b = 80, c=20, d=2;
    unsigned char y = -400, z=20, w=30;
    unsigned char a = b*c/d;
    unsigned char x = y/z*w;
    printf("%d %d",a,x);
    return 0;
}
```

- b) What do you mean by ternary operator? Write a C program that takes mark of a course and prints the corresponding grade based on the following table. Use ternary operator to solve it. (12)

Marks Range	Grade
>=80	A+
>=75 and <80	A
>=70 and <75	B
<70	F

- c) Every C word is classified as either a keyword or an identifier. Is it true? Justify your answer with example. (10)

2. a) Which one is better between else if ladder and switch statement? Explain with suitable example. (09)
 b) Explain the output of the following C code segments: (08)

```
int x = 7;
int y = ++x + ++x;
printf("%d %d", x, y);
```

(i)

```
int a = 3, b=4;
a = a == b == 0;
printf("%d %d", a, b);
```

(ii)

- c) What is the basic difference between function declaration and function definition? Explain why function declaration is necessary. (08)
 d) Write a C program to print the series 1 11 31 61 101 151...N using goto statement. Why goto should be avoided? (10)

3. a) Differentiate between malloc and calloc. Write a program to store information using structure with dynamic memory allocation and show the uses of malloc, calloc and realloc in this program. (13)

- b) Explain the lifetime and scope of the following variables: (i) local, (ii) global, (iii) static local, (iv) static global. (10)

- c) What will be the output of the following programs? Explain your answer. Assume the programs are correct. (12)

```
#include <stdio.h>
void main(){
    int tally;
    for(tally=0;tally<10;++tally){
        printf("#");
        if(tally>6)
            continue;
        printf("%d", tally);
    }
}
```

(i)

```
#include <stdio.h>
void main()
{
    static int val = 4;
    if(--val)
    {
        main();
        printf("%d",--val);
    }
}
```

(ii)

4. a) Implement a function "summation" that will take N values as parameter(s) and return the summation. The data type of the N values will follow the following pattern: int, double, int, double, int, double for N=6. (10)

- b) Suppose, two integer type variables, *value1* and *value2* contain 53 and 17. Now apply the operations (08)
 (i) Bitwise AND, (ii) Bitwise OR, (iii) Bitwise NOT, (iv) Bitwise XOR on *value1* and *value2* and determine the output of each operation. (Assume, `sizeof(int) = 2 bytes`).
- c) Explain the storage location of the following data in main memory: (i) global, (ii) local, (08)
 (iii) dynamically allocated data.
- d) What is parameterized macro? How does it work? Give example. (08)

SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) Suppose, there are multiple inputs from the user end. Input Format: (Suppose, user wants to give three inputs and the input format will be same for each input) (10)

```
175.85.10.147(X):(X)2509(X):(X)easy_question@gmail.com
176.87.10.104(X):(X)3110(X):(X)do_not_worry@outlook.com
175.86.10.140(X):(X)3125(X):(X)find_shortcut@yahoo.com
```

Where, (X) = A white space character, ' '. You need to take each input as a string (for example, you have a character array named, `C_Input` and `C_Input` will contain "175.85.10.147(X):(X)2509(X):(X)easy_question@gmail.com" for Input 1) and then find IP (as a string), NUMBER (as an Integer), EMAIL (as a string) and print those information with the % Format specifier correctly for each input.

Output Format: For Input 1:

```
IP = 175.85.10.147
NUMBER = 2509
EMAIL = easy_question@gmail.com
... ..
... ..
```

- b) Design a structure `student_record` to contain name, date of birth and total marks obtained. Design another structure data type named `date` containing three integer members day, month and year. Use the `date` structure to represent the date of birth. (16)

- i) First, you have to take inputs from the user for all of the variables of the structure and after taking all inputs, you have to print all the given inputs on output console.
- ii) Write a user-defined function "CalculateAgeDifference" which will take two `student_record` type variables and finally, return a `date` type variable which contains the age difference between two students. (Note: Assume, each month has 30 days.)

Sample Input: Enter Total Number of Students = 2

```
Name of the student 1 = Rafi
Date of birth of student 1 = 12/11/1996
Total Marks of student 1 = 205
Name of the student 2 = Nowsin
Date of birth of student 2 = 1/9/1999
Total Marks of student 2 = 185
```

Sample Output for "CalculateAgeDifference" function:

The age difference between the two is: 2years 9months 19days

- c) What is the purpose of the `typedef` feature? Give an example to illustrate it. Explain the outputs (09) of the following programs.

```
#include <stdio.h>
void cal(int *i, int *j){
    *i = *i**i;
    j = i;
    *j = *j**j;
}
int main(){
    int i=2, j=3;
    cal(&i, &j);
    printf("%d %d\n", i, j);
    return 0;
}
```

(i)

```
#include <stdio.h>
int main()
{
    int i=2;
    #ifdef DEF
        i*=i;
    #else
        printf("\n%d", i);
    #endif
    return 0;
}
```

(ii)

6. a) Suppose, you have two 2-dimensional character arrays named, "First_Name" and "Last_Name". (13)
 The number of elements of the two arrays must be equal. Sample elements of two Arrays:

For "First_Name": "Sajib", "Arpita", "Sajid", "", "Nishat"

For "Last_Name": "Islam", "", "Sajid", "Kabir", "Rahman"

You need to generate an output 2-dimensional array named, "Full_Name".

Final contents of "Full_Name":

```
"Sajib Islam", "Arpita", "Sajid", "Kabir", "Nishat Rahman".
```

Finally, you have to print the "Full_Name" array.

- b) Point out the errors if any, otherwise find the outputs of the following programs and explain the outputs. (Note: You need not think about the header file) (10)

```
int main(){
    int a[16] = {0};
    int *head = &a[0];
    int i;
    head++;
    for(i=0;i<15;i++){
        *head++ = head[-1]+2;
        printf("head[-1]=%d, a[%d]=%d\n", head[-1],i,a[i]);
    }
    return 0;
}
```

(i)

```
int main(){
    int s[4][3] = {{1234,56}, {1212}, {1434,80,36}, {1312,78}};
    int (*p) [2];
    int i,j,*pint;
    for(i=0;i<=3;i++){
        p = &s[i];
        pint = p;
        printf("\n");
        for(j=0;j<=2;j++)
            printf("%d",*(pint+j)+1);
    }
    return 0;
}
```

(ii)

- c) In embedded computer systems, the devices managed by a microcontroller are often made to look like ordinary memory locations when viewed by the program executing on the processor. Reading or writing these "Special" device memory locations causes the device to do things or return some information. For instance, a device that launches rockets in a fireworks display might appear to the program as three 4-byte integers in memory starting at some location x: (12)

location	function
x	Command to be performed
x+4	Set to 1 to start doing command
x+8	Status register-read to find out status

In this example, we might launch a rocket by storing the code 17(or whatever code is needed) in location x, then store a 1 in location x+4 to trigger the launch, then we can read the contents of location x+8 to find out what happened. For this problem, complete the implementation of function "control" using the concepts of addresses and pointers. The two parameters to this function are the integer address of the first int in the block that controls the device, and the command code to be stored at that address. The function should store the code at the given address, then set the following int location to 1 to start the command, and finally read the third int and return it as the function value.

7. a) What output does this program produce? (It does compile and execute without errors) (07)

```
#include <stdio.h>
#define magic 13
#ifdef number
#define number 17
#endif
#ifndef number
#define number 42
#endif
#define doubleplus(x,y) x*2+y
#define plusdouble(x,y) x+2*(y)
int main(){
    printf("magic number is %d.%d\n",magic,number);
    printf("%d\n", doubleplus(1+2, 3+4));
    printf("%d\n", plusdouble(3+4, 1+2));
    return 0;
}
```

Explain each output of this program.

- b) Suppose, we have the following two statements in a C program. (08)

```
int *x = malloc(sizeof(int));
int *y = malloc(sizeof(int));
```

For each of the following expressions, write "true" if the expression is always true, "false" if the expression is always false, or "unknown" if the expression could be either true or false depending on what happens when the program is executed.

- i) $(x < y)$
- ii) $(x == y)$
- iii) $((((int)x)+sizeof(int))==((int)y))$
- iv) $(x == NULL)$

Explain each case with correct answer.

- c) Suppose, in a project you have some sensor data in the form of short (16-bit values) array named "givenData". You have to write those data in a file named "data.check" using fwrite function and after that you need to read those data from "data.check" file using fread and store it to "outputData" array. Write a C program for it. (10)

Sample Code (given):

```
short givenData[] = {1, -5, 7, 9, 10, 12, 13};
short outputData [arraySize:you need to determine efficiently];
```

- d) Suppose, we have the following collection of C header and implementation files. (10)

```

thing.h                                impl.h
#ifdef THING_H                             #ifndef IMPL_H
#define THING_H                             #define IMPL_H
...
#endif
                                           ...
                                           #endif

thing.c                                app.c
#include "thing.h"                           #include "thing.h"
#include "impl.h"                           int main() {...}
...

```

Write a Makefile whose default target builds the program app, and which only preprocesses and recompiles individual files as needed. Your Makefile must consider the dependency between the files.

8. a) Write a structure declaration for the following situations. Assume an 8-bit integer word. Define four bit fields, called *a*, *b*, *c* and *d*, whose widths are 6 bits, 6 bits, 3 bits and 5 bits respectively. Force *b* to beginning of the second word of storage. Separate *b* and *c* with 10 vacant bits. (12)
- b) Point out the errors if any, otherwise find the outputs of the following programs and explain the outputs. (Note: you need not think about the header file) (08)

```

union S{
    int i;
    union S *p;
};
int main(){
    union S var1, var2;
    var1.i = 100;
    var2.i = 200;
    var1.p = &var2;
    var2.i = 500;
    printf("\n%d %d", var1.p->i, var2.i);
    return 0;
}

```

(i)

```

int main(){
    char *ar[5]={ "ANIS", "RUMKY", "RAISA"};
    printf("%s %s %c", *(ar+2), *(ar+1)+2, (*(ar+2)+1));
    return 0;
}

```

(ii)

- c) Suppose, there is a character array which is initialized by the below sample character sequence with null characters. (10)

Sample array:

'H'	'I'	'\0'	'B'	'O'	'Y'	'\0'	'&'	'\0'	'G'	'T'	'R'	'L'	'\0'
-----	-----	------	-----	-----	-----	------	-----	------	-----	-----	-----	-----	------

You need to compute the number of characters except the null characters.

Sample Output: The number of characters = 10

Note: Array length is not fixed. You Can't use any string related functions which are in string.h header file.

- d) Given this fragment: (05)

```
char *p, str[80] = "this is a test";
p = str;
```

Show two ways to access the 'i' in "this".

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2017
 Department of Computer Science and Engineering
 CSE 1203
 Digital Logic Design

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is Gray code? Determine a combination for Gray code. (08)
 b) Find the complement of the following Boolean function and reduce them to minimum number of literals. (07)

$$F = B'D + A'BC' + ACD + A'BC$$

 c) Express the following function in sum of minterms and product of maxterms. (09)

$$F(A, B, C, D) = D(A' + B) + B'D$$

 d) What is the difference between Canonical form and Standard form? Which form is preferable when implementing a Boolean function with gates? (06)
 e) What is duality? (05)
2. a) Show that a positive logic NAND gate is a negative logic NOR gate and vice versa. (07)
 b) Justify that any combination of four adjacent squares in the three-variable map results in an expression of only one literal. (06)
 c) Simplify the Boolean function $F(w, x, y, z) = \sum(1, 3, 7, 11, 15)$, where the don't conditions are $d(w, x, y, z) = \sum(0, 2, 5)$, in sum of products and products of sums. (10)
 d) Determine the prime implicants of the function: $F(w, x, y, z) = \sum(1, 4, 6, 7, 8, 9, 10, 11, 15)$ and then show the selection of prime implicants to return minimized function. (12)
3. a) Mention the steps of combinational circuits' design procedure. (06)
 b) Show that a full-adder can be implemented with two half-adders and one OR gate. (08)
 c) Suppose that you are asked to design an alarm circuit which will be operated as follows: (12)
 "The alarm will ring if the alarm switch is turned on and the door is not closed, or the time is between 6 PM and 6 AM and the window is not closed."
 Show the design of this combinational circuit in detail.
 d) Obtain the NAND logic diagram of a full-adder from the Boolean function: (09)

$$C = xy + yz + zx$$

$$S = C'(x + y + z) + xyz$$
4. a) Show that the output carry in a full-adder circuit can be expressed as: (10)

$$C_{i+1} = G_i + P_i C_i = (G_i P_i' + G_i' C_i)'$$

 b) What is priority encoder? Design a 3-bit priority encoder circuit. (09)
 c) What is the significance of Quadruple 2 to 1 line multiplexer? Implement the following function with a multiplexer. (10)

$$F(A, B, C, D) = \sum(0, 1, 3, 4, 8, 9, 15)$$

 d) Construct a 5x32 decoder with four 3x8 decoders and a 2x4 decoder. (06)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) How does combinational circuit differ from sequential circuit? (06)
 b) "Circuit design with JK flip-flop gives more don't care options with respect to other flip-flop" – justify the statement with flip-flop excitation table. (09)
 c) Design a counter with the following binary sequence: 1, 8, 0, 7, 0, 1, 9 and repeat. Use T flip-flops in this design. (10)

- d) Design sequential circuit with JK flip-flops to satisfy the following state equations: (10)

$$A(t+1) = A'B'CD + A'B'C + ACD + AC'D'$$

$$B(t+1) = A'C + CD' + A'BC'$$

$$C(t+1) = B$$

$$D(t+1) = D'$$

6. a) "If Q' output of a D flip-flop is connected to the D input then it acts as T flip-flop" – justify the statement. (07)
- b) What are the rules for state reduction? Reduce the number of states in the following state table and tabulate the reduced state table. (13)

Present State	Next State		Output	
	x=0	x=1	x=0	x=1
A	B	C	0	0
B	D	E	0	0
C	F	G	0	0
D	H	I	0	0
E	J	K	0	0
F	L	M	0	0
G	N	P	0	0
H	A	A	0	0
I	A	A	0	0
J	A	A	0	1
K	A	A	0	0
L	A	A	0	1
M	A	A	0	0
N	A	A	0	0
P	A	A	0	0

- c) A sequential circuit has two flip-flops (A and B), two inputs (x and y) and an output (z). The flip-flop input functions and the circuit output functions are as follows: (15)

$$JA = xB + y'B'$$

$$JB = xA'$$

$$KA = xy'B'$$

$$KB = xy' + A'$$

$$z = xyA + x'y'B$$

- (i) Draw the logic diagram, (ii) Draw the state table, (iii) Draw the state diagram, and (iv) Find the state equation.

7. a) The context of a 4-bit shift register is initially 1101. The register is shifted six times to the right with the serial input 101101. What is the context of the register after each shift? (06)
- b) Design a sequential circuit with two SR FFs A and B and two inputs E and x. If E=0, the circuit remains in the same state, regardless of the value of x. When E=1 and x=1, the circuit goes through the state transitions from 00 to 01 to 10 to 11 back to 00, and repeats. When E=1 and x=0, the circuit goes through the state transitions from 00 to 11 to 10 to 01 and back to 00, and repeats. (13)
- c) Draw a circuit diagram of a serial adder with sequential circuit and explain its operation. (11)
- d) Differentiate between register and latch. (05)
8. a) Design a 4096 bit ROM whose word size is 4 bit. (06)
- b) What is PLA? What are the advantages of PLA over ROM? (07)
- c) A combinational circuit is defined by the following functions: (12)

$$F_1(A, B, C) = \sum(3, 5, 6, 7)$$

$$F_2(A, B, C) = \sum(0, 2, 4, 7)$$

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

- d) Show the design of a 4-bit parallel load register with a load line using SR flip-flop. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2017
 Department of Computer Science and Engineering
 EEE 1217
 Analog Electronics

TIME: 3 hours

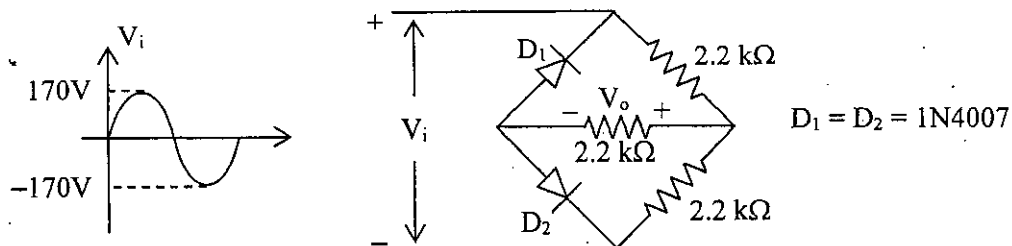
FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
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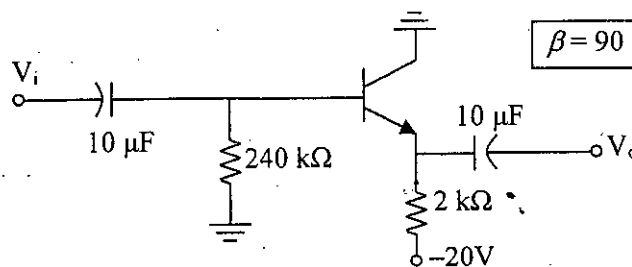
SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Explain semiconductor and doping of semiconductor. What are the effects of temperature on semiconductor device? (08)
- b) Draw the energy band diagram of a *p-n* junction under (i) forward bias, and (ii) reverse bias conditions. (06)
- c) Discuss the importance of PIV in rectifier diode. Why is the bridge rectifier more efficient than others? (08)
- d) Show that a zener diode acts as a voltage regulator. Determine the output waveform for the following network and calculate the output dc level and the required PIV of each diode. (13)



2. a) Why transistor is named so? Describe the construction and working principle of a PNP transistor. (14)
- b) Determine V_{CE} and I_C for the network shown in figure below. (12)



- c) Mention the main features of amplifiers. (06)
- d) Mention some differences between common emitter and common base configuration of BJT. (03)

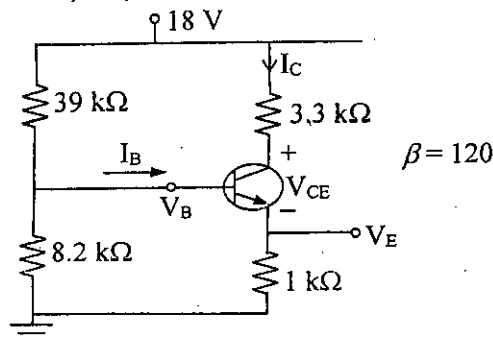
3. a) What is hybrid parameter? Why they are so called? Show that, the voltage gain of a common emitter amplifier is (10)

$$A_V = \frac{-h_{fe}}{z_{in} \left(h_{oe} + \frac{1}{r_L} \right)}$$

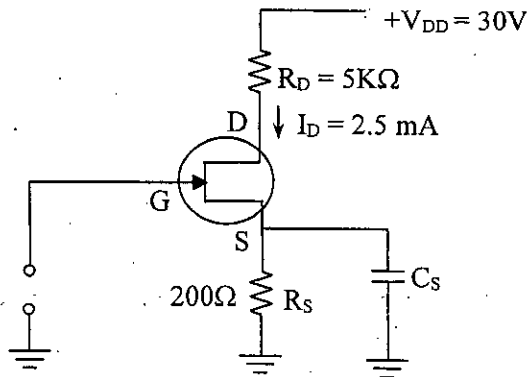
- b) Draw a darlington pair circuit. Show that for a darlington pair, the overall gain is $\beta^2 = \beta_1 \times \beta_2$, where the symbols have their usual meanings. (10)

- c) What are the main differences between BJTs and FETs? (05)

- d) Determine the DC bias voltage V_{CE} and the current I_C for the voltage divider configuration shown below. Also determine I_B , V_B , and V_E . (10)



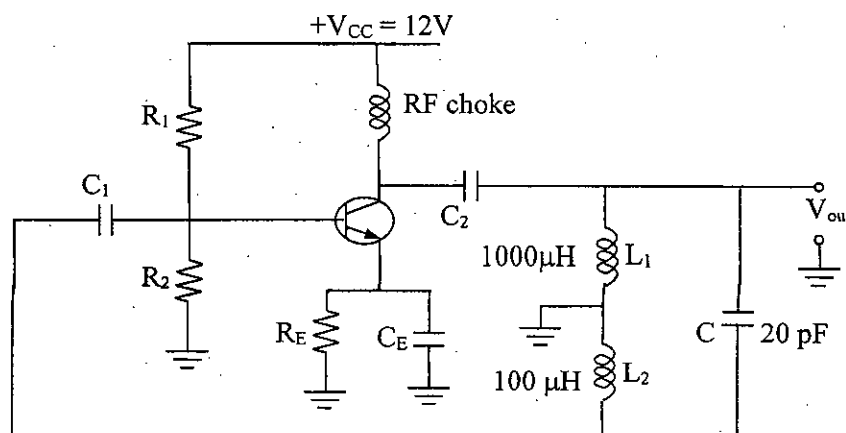
4. a) What do you mean by FET? Draw the construction and working principle of *n*-channel JFET. (14)
- b) Write down the major difference between depletion type MOSFET and enhancement type MOSFET. (06)
- c) What is CMOS? How does CMOS act as a logic inverter? (09)
- d) In the JFET circuit shown below, find (i) V_{DS} and (ii) V_{GS} . (06)



SECTION B

(Answer ANY THREE questions from this section in Script B)

5. a) Why silicon controlled rectifier, not Germanium controlled rectifier? Draw the constructional figure of a SCR and explain its principle of operation. (12)
- b) Explain the working principle of SCR full-wave rectifier with neat sketch. Also derive the expression of output voltage and current. (09)
- c) Write down the applications of SCR, DIAC, and TRIAC. (09)
- d) A 24V r.m.s. supply is connected to a half-wave SCR circuit that is triggered at 50° . What is the d.c. voltage delivered to the load? (05)
6. a) Draw the symbols and constructional diagram of TRIAC and DIAC. How a DIAC can be used as a lamp dimmer, explain with necessary diagram. (11)
- b) What do you mean by active filter? Draw and explain the following active filter circuits. (12)
- A second order high pass filter
 - A band stop filter.
- c) Why is dc power supply needed? What do you mean by UPS? Explain three different types of UPS with proper diagram. (12)
7. a) What is operational amplifier? Mention the basic features of an op amp. (08)
- b) How op amp act as a (i) differentiator, (ii) integrator and (iii) adder? (09)
- c) Show that the output voltage of a differential amplifier is proportional to the difference of the two input voltages. (10)
- d) Write short notes on virtual ground, CMRR and slew rate. (08)
8. a) Why IC is needed? Classify IC. How a diode is formed in a monolithic IC, explain with necessary diagrams. (12)
- b) Define oscillator. What are the essential parts of an oscillator? Explain the principle of operation of phase shift oscillator. (12)
- c) Write down the limitations of LC and RC oscillators. Calculate the (i) operating frequency and (ii) feedback fraction for Hartley oscillator shown below. The mutual inductance between the coils, $M = 20 \mu\text{H}$. (11)



KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 2nd Term Examination, 2017
Department of Computer Science and Engineering
MATH 1207

Coordinate Geometry and Differential Equations

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Find the rectangular and spherical polar coordinates for a point whose cylindrical polar coordinates is $(3, \frac{2}{3}\pi, 4)$. (10)
- b) Find the equation of the right circular cylinder of radius 2 whose axis passes through $(-1, 2, 3)$ and has direction ratios 1, 0, -2. (13)
- c) Find the centre and nature of the surface represented by the following equation: (12)
$$x^2 + 2y^2 - 3z^2 - 4yz + 8zx - 12xy + 1 = 0$$
2. a) A variable plane is at a constant distance p from the origin and meets the axes in A, B, C . (12)
Show that the locus of the centroid of the tetrahedron $OABC$ is $x^{-2} + y^{-2} + z^{-2} = 16p^{-2}$.
- b) Find the equation of the plane passing through points $(2, 3, -4)$ and $(1, -1, 3)$ and parallel to the x -axis. (11)
- c) Verify whether the lines $\frac{x-1}{2} = \frac{y}{-3} = \frac{z+2}{-1}$ and $\frac{x}{-1} = \frac{y+3}{-2} = \frac{z-2}{1}$ are coplanar or not. If coplanar, then find the equation of plane containing them. (12)
3. a) Find the length and equation of S.D. between the lines whose equations are (15)
 $\frac{x-1}{4} = \frac{y-2}{3} = \frac{z-36}{-6}$ and $x+y=0, z=4$.
- b) Find the equation of the sphere passing through the circle $x^2 + y^2 + z^2 - 9 = 0$, $2x + 3y + 4z - 5 = 0$ and the point $(1, 2, 3)$. (10)
- c) Find the equation of the right circular cone whose axis is $x = y = z$, vertex is origin and whose semi-vertical angle is 45° . (10)
4. a) When the general equation of second degree represents (07)
 - i) a parabola
 - ii) an ellipse
 - iii) a rectangular hyperbola.
- b) Reduce the equation $x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$ to the standard form and identify the conic. Also, find the equation of axis. (18)
- c) Transform the equation $2x^2 + y^2 - 4x + 4y = 0$ when the origin is shifted to $(1, -2)$ keeping the direction of axes unchanged. (10)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define singular point, regular singular point and ordinary point of a differential equation. (05)
- b) Find the series solution of $x^2 y'' - xy' + (x^2 + \frac{8}{9})y = 0$. (30)
6. a) Find a particular solution of $y'' + 3y' + 2y = 0$ when $y(0) = 0$ and $y'(0) = 1$. (09)
- b) Solve $\sqrt{x+y+1} \left(\frac{dy}{dx}\right) = 1$. (08)

c) Solve $\frac{\partial y}{\partial t} = 4 \frac{\partial^2 y}{\partial x^2}$, $0 < x < \pi$, $t > 0$ subject to the boundary conditions $y(0, t) = y(\pi, t) = 0$ (18)
and $y(x, 0) = -4 \sin 5x$.

7. Solve any three of the followings: (35)

i) $(x^3 + xy^4)dx + 2y^3dy = 0$

ii) $y^2dx + (x^2 - xy + y^2)dy = 0$

iii) $(3x - 7y - 3)dy - (3y - 7x + 7)dx = 0$

iv) $\frac{dy}{dx} = \sin(x + y) + \cos(x + y)$.

8. Solve any three of the following differential equations: (35)

i) $y'' - 6y' + 9y = xe^{3x} \sin 2x$

ii) $(D^2 - 5D + 4)y = 3x + 2e^x + 4e^{3x}$

iii) $y'' - 3y' + 2y = \frac{1}{1 + e^{-x}}$

iv) $y'' + y = \cot x$, where $y'' = \frac{d^2y}{dx^2}$.