

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2023
 Department of Computer Science and Engineering
 CSE 1203
 Digital Logic Design

TIME: 3 hours

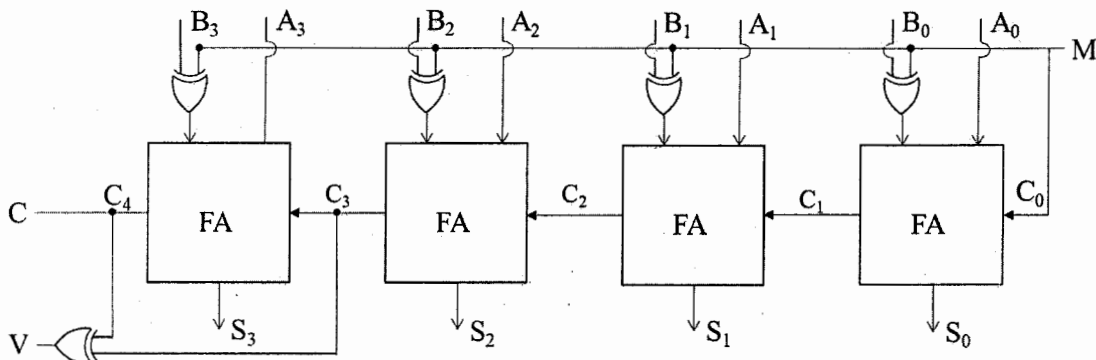
FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the immediate right column of the questions indicate full marks.
 iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) Perform BCD addition to add $(+867)_{10}$ and $(-713)_{10}$ (use the radix complement if necessary). (10) [CO1]
 - b) The Boolean expression of $F = A'C' + CD' + BC + AC$ is a simplified version of the expression $F = A'B'C + A'C'D' + A'BCD + B'CD' + AB'C$. Are there any don't care conditions? If so, what are they? (12) [CO2]
 - c) Simplify the Boolean function $F(w, x, y, z) = \sum(0, 6, 8, 13, 14)$ with the don't care conditions $d(w, x, y, z) = \sum(2, 4, 10)$. Write a Verilog module to implement the simplified function. (13) [CO2]
2. a) Consider the four-bit adder-subtractor with overflow detection shown in following figure. (20) [CO2]



- i) Modify the circuit to detect negative results and zero result during subtraction operation and give the original output as the current circuit gives 2's complement output during subtraction.
 - ii) Explain how the modified circuit can be a comparator circuit using the outputs.
- b) Design a BCD-to-7-segment Decoder using PLA whose Boolean functions are simplified. (15) [CO3]
3. a) A traffic monitoring system for controlling the release of traffic from an entrance ramp onto a superhighway has the following specifications for a part of its controller. There are three parallel metering lanes, each with its own stop (red) - go (green) light. One of these lanes, the car pool lane, is given priority for a green light over the others two lanes. Otherwise, a "round robin" scheme in which the green lights alternate is used for the other two (left and right) lanes. The part of the controller that determines which light is to be green (rather than red) is to be designed. The specifications for the controller are given in Table I, Table II, and Table III. Now, design the controller using minimum gate input cost of AND-OR-Inverters. (20) [CO2]

Table I: Inputs

Sensor	Description
PS	Car pool lane (Present – 1, absent – 0)
LS	Left lane sensor (Present – 1, absent – 0)
RS	Right lane sensor (Present – 1, absent – 0)
RR	Round robin signal (select left – 1, select right – 0)

Table II: Outputs

PL	Car pool lane light (green – 1, red – 0)
LL	Left lane light (green – 1, red – 0)
RL	Right lane light (green – 1, red – 0)

Table III: Operations

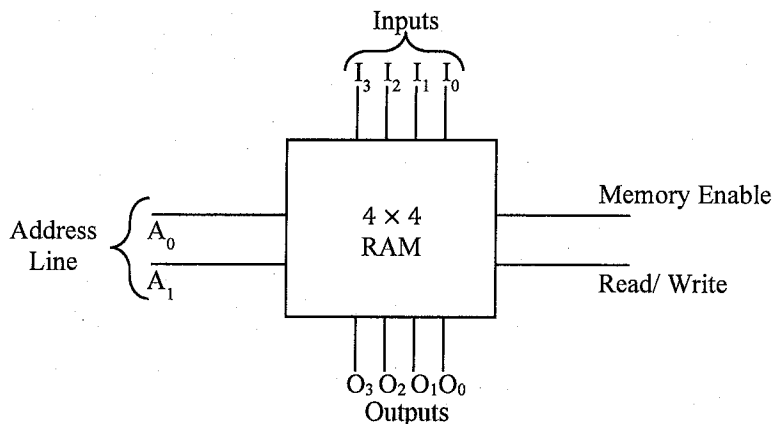
1.	If there is a car in the car pool lane PL is 1.
2.	If there are no cars in the car pool lane and the right lane and there is a car in the left, LL is 1.
3.	If there are no cars in the car pool lane and the left lane and there is a car in the right lane, RL is 1.
4.	If there are no cars in the car pool lane and there are cars in right and left lanes, then for RR=1, LL=1 and for RR=0, RL=1.
5.	If any PL, LL, or RL is not specified to be 1 above, then it has value 0.

b) Minimize the following function using K-map method: (15) [CO2]

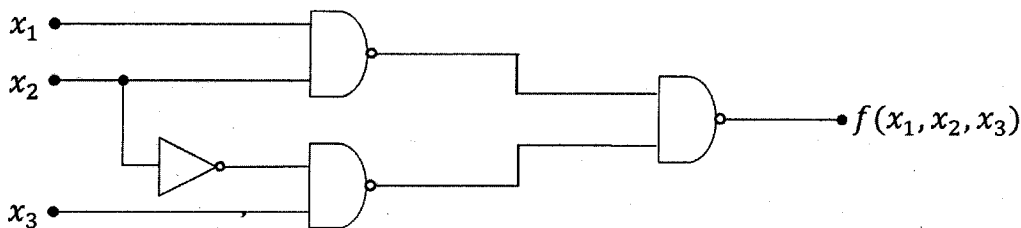
$$F(A, B, C, D, E) = \sum_m (3, 11, 12, 19, 23, 29) + \sum_d (5, 7, 13, 27, 28)$$

Hence, implement the minimized function using NAND gates only.

4. a) Enclose the 4×4 RAM of following figure which shows a block diagram with all inputs and outputs. Assuming three-state output, construct an 8×8 memory using four 4×4 RAM units. (10) [CO3]



b) Explain the different kind of hazards that may present in combinational networks. (15) [CO3] Identify the kind of hazards present in the following network. Explain how to remove it from the network.



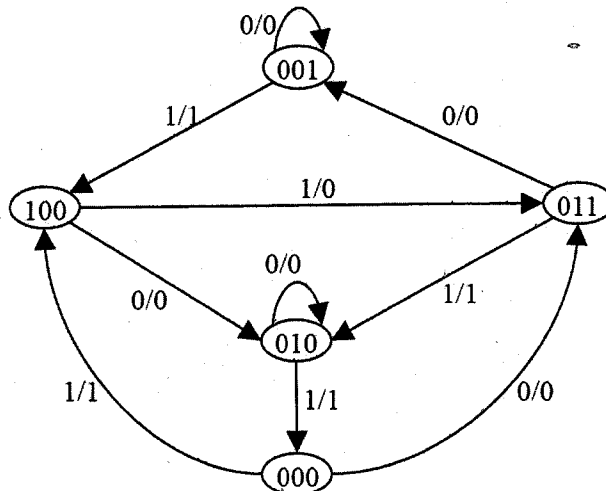
c) Show that the output carry in a full-adder circuit can be expressed as: (10) [CO1]

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

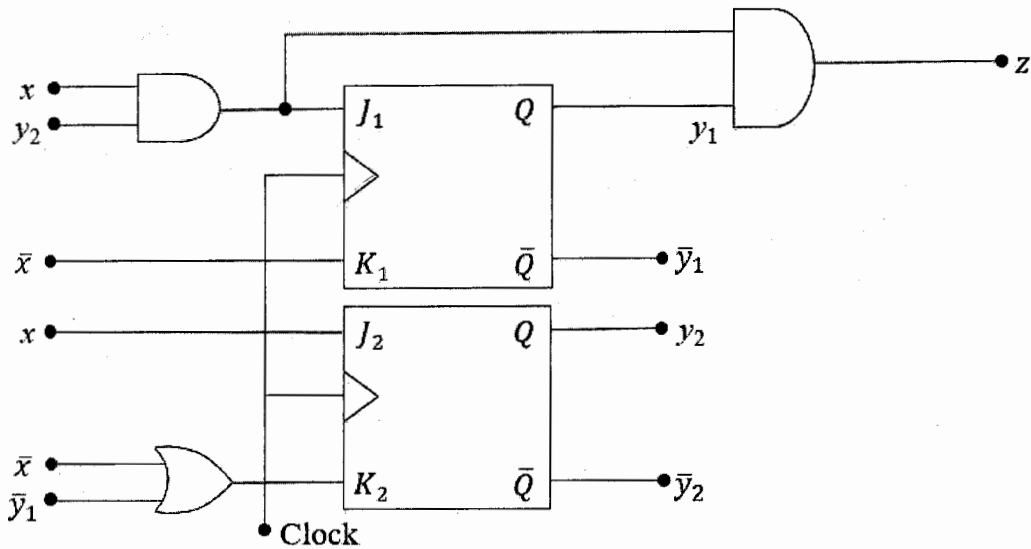
SECTION B

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

- What is a sequential circuit? Explain different kind of sequential circuit models using example(s). (12) [CO1]
- “Circuit design with JK flip-flop gives more don't care options with respect to other flip-flops” – justify the statement with flip-flop excitation tables. (10) [CO2]
- For the following state diagram, design a Mealy-machine using T-flip-flops. The circuit will have one input and one output. (13) [CO3]



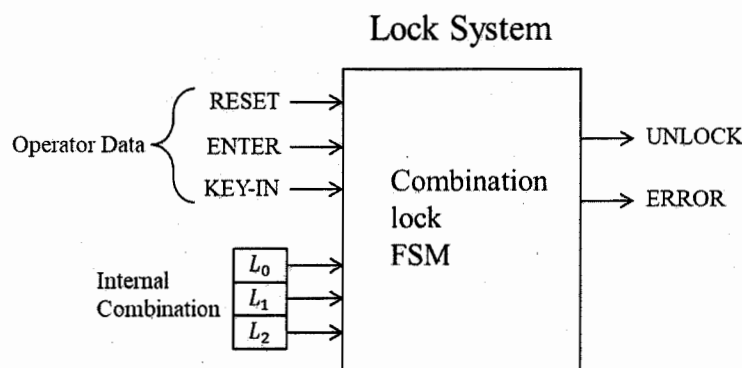
6. a) Analyze the following sequential circuit in terms of the followings: (15) [CO3]
 i) Input and output equations.
 ii) State table and state diagram.



- b) Explain the steps for sequential circuit design procedure using an example. (08) [CO2]
 c) Design a synchronous counter with *JK* flip-flops for the binary sequence 0, 1, 4, 5, 7 and repeat. (12) [CO3]
7. a) What is an asynchronous counter? Draw a decade binary asynchronous counter with *JK* flip-flops and explain its operation. (10) [CO3]
 b) What do you mean by state reduction and state assignment? Reduce the number of states in the following state table. Hence, provide an optimal state assignment. (10) [CO3]

Present State	Next State		Output	
	$x = 0$	$x = 1$	$x = 0$	$x = 1$
<i>a</i>	<i>a</i>	<i>b</i>	0	0
<i>b</i>	<i>c</i>	<i>d</i>	0	0
<i>c</i>	<i>a</i>	<i>d</i>	0	0
<i>d</i>	<i>c</i>	<i>f</i>	0	1
<i>e</i>	<i>a</i>	<i>f</i>	0	1
<i>f</i>	<i>g</i>	<i>f</i>	0	1
<i>g</i>	<i>a</i>	<i>f</i>	0	1

- c) An engineer has been asked to design a synchronous sequence detector circuit. The detector has one input (x) and one output (z). The circuit examines group of four consecutive inputs and produces an output $z = 1$ if the input sequence 0101 or 1001 occurs. The circuit resets after four inputs. Now, you have to design the sequence detector circuit as an engineer using *D* flip-flops only. (15) [CO3]
8. a) What is a Johnson counter? Draw and explain the operation of a 4-bit Johnson counter. (08) [CO1]
 b) What is a register? Explain the design of a 4-bit parallel load register with a load line using *D* flip-flops. (10) [CO1]
 c) An engineer has been asked to design a digital combinational lock system. The specification of the lock system is as follows: (17) [CO3]
 “3-bit serial lock controls entry to the locked room. Inputs are RESET, ENTER, 2 position switch for bit of key data. Locks generate an UNLOCK signal when key matches internal combination. An ERROR light illuminates if key does not match combination.”
 Now you have to design the lock system. Make reasonable assumptions if required. The block diagram of the lock system is shown below.



KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2023
 Department of Computer Science and Engineering
 CSE 1205

Object Oriented Programming

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the immediate right column of the questions indicate full marks.
 iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) The concept of friend class exists in C++, but is absent in Java. Why do you think friend classes are excluded in Java? Why does the friend function violate the idea of Object-Oriented Programming (OOP)? (15) [CO1]
 b) Given the following code snippet, declare a class Array and implement the necessary member functions so that the code produces the expected output. (12) [CO2]

<pre>int main(){ Array <int,10> a; for(int i=0; i<10; i++) a[i]=i; for(int i=-10; i<0; i++) cout<<a[i]<<' '; }</pre>	<p>Expected Output: 0 1 2 3 4 5 6 7 8 9</p>
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- c) How does generic programming help save memory? Explain with an example. (08) [CO4]
2. a) Is it possible to invoke a member function without instantiating an object? Provide a proper example to justify your answer. (07) [CO1]
 b) How can you overload double subscript '[][]' operator in C++? Explain with coding example. (10) [CO2]
 c) Consider a Student class with two member data: roll & CGPA. Implement the following member function of Student class. (12) [CO4]
 i) void write-to-disk(string file_name): the function should take data of a Student object from console and save it to the specified file.
 ii) void read-from-disk(string file_name, int sn): the function should read the data of the sn-th student from the specified file and display it on console.
 d) Write a simple program in C++ that asks a student to enter his/her expected grade in CSE 1205. If the student presses enter without entering a grade 'A+' is stored by default. (06) [CO4]

3. a) What will be the output of the following code snippet? Provide an explanation to support your answer. (10) [CO4]

<pre>template <class A,class B> class Static{ public: static int counter; Static(){ cout<<++counter<<endl; } };</pre>	<pre>template <class A,class B> int Static<A,B>::counter=0; int main(){ Static<int,int> a,b; Static<int,char> c; Static<char,int> d,e; Static<int,char> p; }</pre>
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- b) How can you convert an object into a callable entity? Demonstrate with an example. (10) [CO4]
 c) Given the following code snippet, implement the necessary member function for the Complex class to ensure that the code produces the expected output. (15) [CO2]

<pre>class Complex{ float real, imaginary; public: Complex(){} };</pre>	<pre>int main(){ Complex c(0,0); c=4+c+5; cout << c <<endl; }</pre>	<p>Expected Output: 5+4i</p>
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4. a) In OOP, it is said that data is kept hidden. Could you explain why the data is in hidden (10) [CO1] from?
- b) What will be the output of the following code? Provide explanation to support your (10) [CO2] answer.

<pre>void add(int x, int y){ cout << "x+y" <<endl; } void add(char a, float b){ cout << "a+b" <<endl; } void add(double p, float q){ cout << "p+q" <<endl; }</pre>	<pre>int main(){ add('b', 3.2); add(0, 'b'); add('a', 5); add(1.9, 2.1); add(1, '0'); }</pre>
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- c) Create an array container class with bound-checking and dynamic resizing (when (15) [CO3] elements are added) capability.

SECTION B

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

5. a) Discuss the advantages of OOP over structured programming. (10) [CO1]
- b) Explain Aggregation and Composition with proper coding example(s). (10) [CO1]
- c) How compiler handles runtime polymorphism via Dynamic Dispatching? Explain with (15) [CO3] necessary figure(s) and coding implementation.
6. a) "Every interface is abstract class but every abstract class is not interface"—justify the (10) [CO1] statement with example(s).
- b) What ambiguity problem may occur in multiple inheritance? Discuss different (10) [CO3] techniques that can solve this problem with coding example(s).
- c) Class 'Shape' has pure virtual function named 'area'. Class 'Rectangle' and 'Triangle' (15) [CO3] inherit class 'Shape'. Class 'Rectangle' has a member function named 'RectDraw'. Create a program to randomly generate 3 objects of both derived classes at runtime and handle them via array of 'Shape' pointer. Now determine class type of each Shape object, display calculated area, and call 'RectDraw' function if the object is a 'Rectangle' (without using built-in runtime type identification mechanism).
7. a) Explain with an example how dynamic_cast can sometimes be an alternative to typeid. (10) [CO3]
- b) How runtime type identification and dynamic -casting can be used together to solve the (10) [CO3] limitation of using base pointer (while accessing derived classes extra properties or functions)
- c) Write a program in OOP style to add two 2 × 2 Matrix of complex numbers. Write the (15) [CO2] declaration of complex number class into ComplexNumber.h file and definition into ComplexNumber.cpp file. Then create a template class Matrix to perform the matrix addition.
8. a) How namespace can be used for organizing code and avoiding conflicts? Explain with (10) [CO1] coding example.
- b) What mistake prevents the following class declaration from functioning properly as an (15) [CO2] abstract class? Propose a solution for this.

```
class Shape{
public:
    virtual double print() const;
    double area() const{
        return base*height;}
};
private:
    double base;
    double height;
};
```

- c) How method chaining works in C++? Is it possible to overload '<<' operator as a (10) [CO2] member function?

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2023
 Department of Computer Science and Engineering
 EEE 1207

Basic Electrical Engineering

TIME: 3 hours

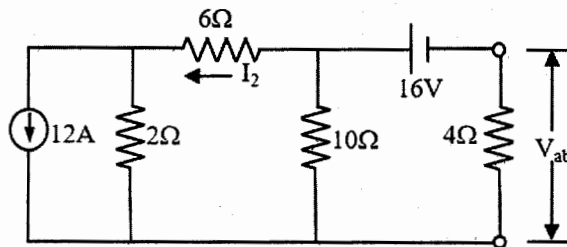
FULL MARKS: 210

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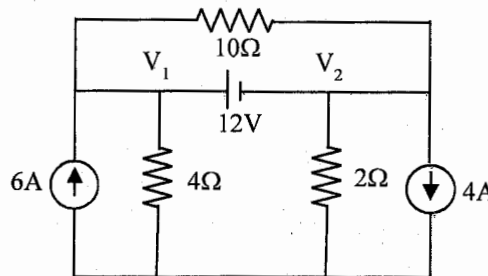
SECTION A

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

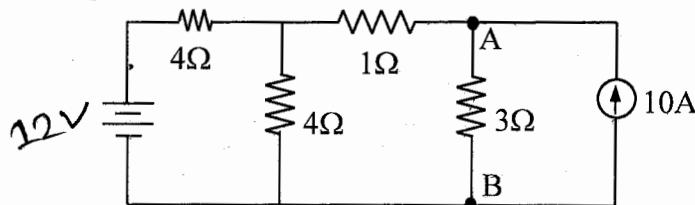
1. a) State and explain Ohm's law, KVL and KCL. (09) [CO1]
 b) Using mesh analysis, determine the value of I_2 and V_{ab} of the following circuit. (13) [CO1]



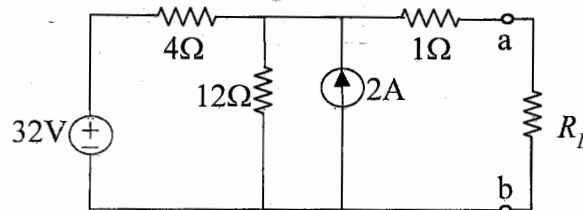
- c) Define supernode. Use nodal analysis to find the values of V_1 and V_2 as shown in the following figure. (13) [CO1]



2. a) State the conditions for applying superposition theorem to a circuit. Using the theorem, find current through 3Ω resistance of the terminal AB shown in the following figure. (13) [CO4]



- b) Determine the Thevenin's equivalent circuit shown in the following figure for the terminal a-b. Find the current through $R_L = 6\Omega$. (13) [CO4]



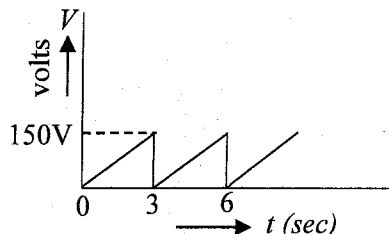
- c) What is electrical source? Classify electrical sources. Define independent and dependent sources. (09) [CO1]
3. a) State Ohm's law for magnetic circuit. Make a comparison between the electric circuit and magnetic circuit. (12) [CO1]
 b) Classify different measuring instruments and mention their applications. How can the range of ammeter and voltmeter be extended? (11) [CO1]
 c) A 4-pole, long-shunt lap-wound generator supplies 25 kW at a terminal voltage of 500V. The armature resistance is 0.03Ω , series field resistance is 0.04Ω and shunt field resistance is 200Ω . The brush drop is 1V. Determine the emf generated. Also find the number of conductors when the speed is 1200 rpm and flux per pole is 0.02 wb. Neglect armature reaction. (12) [CO3]

4. a) Explain the operating principle of a dc generator and motor. Draw the power stages of a dc generator and find the conduction for obtaining maximum efficiency. (12) [CO1]
 b) How can speed of a dc motor be controlled? Explain the flux control method. (11) [CO2]
 c) A 25 kW, 250V dc shunt generator has armature and field resistances of 0.06Ω and 100Ω respectively. Determine the total armature power developed when working (i) as a generator delivering 25 kW output, and (ii) as a motor. (12) [CO3]

SECTION B

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

5. a) Define with necessary diagram: (i) Oscillating current, (ii) Periodic current, (iii) Alternating current, (iv) Period, and (v) Cycle. (10) [CO1]
 b) What is impedance of ac circuit? Derive the expression of impedance of an RLC series circuit with necessary vector diagram. Also find its power equation. (12) [CO2]
 c) A pure inductance of 318 mH is connected in series with a pure resistance of 75Ω . The circuit is supplied from 50 Hz source. The volage across 75Ω resistor is found to be 150V. Calculate the supply voltage and phase angle. (13) [CO3]
6. a) Deduce the equations of energy during a quarter cycle of an inductor and capacitor. (11) [CO2]
 b) A resistance of 10 ohm is in series with $303-\mu F$ capacitor. If the voltage drop across the capacitor is $150 \sin(220t - 60^\circ)$ volts, find the equation with respect to time of the voltage drop across the entire series circuit. Also find the expression for the current at any time t . (12) [CO4]
 c) Define form factor and crest factor. Find the form factor and crest factor of the sawtooth wave shown in the following figure. (12) [CO3]



7. a) What is phasor? Write down the significance of operator j . Find all the possible roots of
$$\sqrt[3]{\frac{10\angle 45^\circ 5e^{j60}(-4.047-j2.94)}{1-j1.732}}$$
 (12) [CO1]
 b) Draw the equivalent circuits of a transformer and find the total impedance between input and terminals. (10) [CO2]
 c) Mention the differences between alternator and synchronous motor. What are the advantages of stationary armature in an alternator? Describe V-curves. (13) [CO1]
8. a) What are the losses in a transformer? Define efficiency and find the condition for maximum efficiency. (11) [CO2]
 b) What are the main four parameters of a transformer? How can they be determined? Describe transformer test in details. (12) [CO2]
 c) What are different types of 3- ϕ transformer connections? Describe them briefly. (12) [CO2]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 2nd Term Examination, 2023
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 immediate right column of the questions indicate full marks.
iii) The rightmost column indicates the course outcomes.

SECTION A

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

1. a) Define unit cell and crystal lattice. Derive the relation between the interplanar spacing of a crystal and the wavelength of X-ray diffracted by it. (10) [CO2]
b) Calculate the Miller indices of a crystal plane which is cut through the crystal axes $4a$, $-2b$, $-5c$. (08) [CO1]
c) The density of Lithium metal is 0.53 g.cm^{-3} and the separation of (100) planes of metal is 350 pm. Determine whether the lattice is face centered cubic or body centered cubic (molar mass of Lithium = 6.941 g.mol^{-1}). (07) [CO3]
d) "Silicon is preferred over germanium in semiconductor industry" – explain based on their inherent chemical properties. (10) [CO4]
2. a) " N_2 molecule possesses resonance structure and paramagnetic in nature" – explain the statement with the help of molecular orbital theory and draw its resonance structure. (10) [CO2]
b) "Metals are the malleable and ductile" – illustrate with examples. (10) [CO1]
c) Interpret why sigma bond is stronger than pi bond, based on valance bond theory. (07) [CO1]
d) What is meant by hydrogen bond? Discuss the bonding properties of water. (08) [CO2]
3. a) What is energy storage device? Draw a flowchart for the classification of battery. (08) [CO1]
b) Illustrate with reaction mechanism, the principle of Lithium polymer battery. (10) [CO2]
c) 0.5 N solution of a salt placed between two electrodes, 40 cm apart and area of cross section 5.0 cm^2 has a resistance of 30 ohms. Calculate the equivalent conductance of the solution. (07) [CO2]
d) What is super-capattery. Mention the differences between battery and capacitor. (10) [CO1]
4. a) What is zeta potential? How does zeta potential relate with double layer capacitance in electrochemistry? Explain. (08) [CO5]
b) Define electromotive force (EMF). Derive Nernst equation for determining EMF. (10) [CO4]
c) Explain K-bands and R-bands of UV-visible spectrum. (10) [CO4]
d) Describe the action mechanism of microwave oven. (07) [CO5]

SECTION B

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

5. a) Define photochemical and thermal reactions with examples. (08) [CO1]
b) State and explain the laws of photo-chemistry. (10) [CO2]
c) What is quantum yield? Calculate quantum yield of a reaction having products 100 mole and the absorbed energy is 10 Einstein. (10) [CO5]
d) Explain the term chemiluminescence. (07) [CO5]
6. a) Define the terms polymerization and degree of polymerization with examples. (08) [CO1]
b) What is conducting polymer? Compare the conduction mechanism of conducting polymer and copper wire. (10) [CO2]
c) What do you mean by free radical? Describe the free radical mechanism of polymerization process. (10) [CO2]
d) Synthesize and mention the uses of Bakelite polymer. (07) [CO5]
7. a) What do you mean by IC_{50} , LC_{50} , LD_{50} , and ED_{50} of a new compound? Explain. (08) [CO1]
b) Describe the hydrologic cycle and nitrogen cycle. (10) [CO1]
c) Outline the inter accumulation mechanism of radio active pollutants among soil, water, plants, and human body. (10) [CO5]

- d) Explain the impact of concept of green-house effect on the development of agro products. (07) [CO5]
8. a) Define the term photosensitized reaction with example. (08) [CO1]
b) What are the heavy metals? Mention the impact of heavy metals on water pollution. (10) [CO5]
c) Synthesize and mention the uses of conducting polymer polyaniline. (10) [CO2]
d) What is chemical corrosion? Discuss the chemical theory of corrosion. (07) [CO5]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 2nd Term Examination, 2023
 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 immediate right column of the questions indicate full marks.
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SECTION A

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

1. a) Find the transformed equation of $x^2 - 4xy + y^2 + 1 = 0$ when the equations of $x - y = 0$ and $x + y = 0$ are considered as the x and y axes, respectively. (11) [CO3]
 b) Determine the rotational angle of the rectangular axes to remove the xy -term from the equation $4x^2 + 2\sqrt{3}xy + 2y^2 - 1 = 0$ and hence find the transformed equation. (11) [CO3]
 c) Establish the standard equation of $4x^2 - 4xy + y^2 - 8x - y + 6 = 0$ and also find its vertex. (13) [CO3]
2. a) Define direction ratios of a line. (02) [CO1]
 b) Compute the original length and the direction cosines of a line segment PQ , whose projections on the x , y and z -axes are a , b , c , respectively. (11) [CO3]
 c) Find the coordinates of $(-3, 4, -5)$ in cylindrical and spherical polar coordinates. (10) [CO2]
 d) Test whether the four points $(0, 1, 2)$, $(3, 0, 1)$, $(4, 3, 6)$ and $(2, 3, 2)$ coplanar or not, and calculate the followings: (12) [CO4]
 i) If coplanar, then find the equation of plane containing them, or
 ii) If non-coplanar, then find the volume of a tetrahedron whose vertices are these four points.
3. a) Find the equations of the planes represented by: (12) [CO3]
 $16x^2 - 8y^2 - 21z^2 + 8xy + 34yz + 16zx = 0$.
 Also, find the angle between them.
 b) Find the distance from the point $(-1, 4, 5)$ to the plane $x + y + z + 4 = 0$ measured parallel to the line $\frac{x-1}{2} = \frac{y-2}{-3} = \frac{z-3}{6}$. (11) [CO3]
 c) Find the center and radius of the circle represented by: (12) [CO3]
 $x^2 + y^2 + z^2 - 2x + 4y - 6z - 22 = 0$, $2x - y + 5z + 11 = 0$.
4. a) Define skew-lines. (02) [CO1]
 b) Find the length of the shortest distance between the skew-lines: (12) [CO3]
 $\frac{1}{3}(x - 3) = -(y - 8) = (z - 3)$ and $-\frac{1}{3}(x + 3) = \frac{1}{2}(y + 7) = \frac{1}{4}(z - 6)$.
 c) Find the angle between the line of intersection of the planes $2x - 3y + 4z - 5 = 0$ and $3x + 4y - 5z - 7 = 0$ with the plane $x + y - z + 3 = 0$. (10) [CO3]
 d) Find the equation of right circular cone, whose vertex is at $(0, 0, 0)$ and the guiding curve $x^2 + y^2 = 4$, $z = 2$. (11) [CO3]

SECTION B

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

5. a) Explain linearity and nonlinearity of a differential equation (D.E) with example. (04) [CO2]
 b) Find the D.E corresponding to the equation $y = ae^x + be^{2x} + ce^{-3x}$, where a , b , and c are arbitrary constants. (11) [CO2]
 c) Determine the general solution of $(x + y) dx - x dy = 0$. (10) [CO3]
 d) Find the general solution of the D.E $\frac{dy}{dx} = \sin(x - y) + \cos(x - y)$. (10) [CO3]
6. a) Solve the D.E $(y + x - 5) dy = (y - x + 1) dx$. (12) [CO3]
 b) Solve the initial-value problem $x \frac{dy}{dx} + y = (xy)^{3/2}$, $y(1) = 4$. (12) [CO3]
 c) Solve the D.E $\frac{dy}{dx} - 2y = 3xy^5$. (11) [CO3]

7. a) Solve the initial value problem: (10) [CO3]

$$y'''' + 6y''' + 11y'' + 6y' = 0, \quad y(0) = 0, \quad y'(0) = 1, \quad \text{and} \quad y''(0) = -1.$$

b) Solve the D.E $(D^3 - 2D^2 - 5D + 6)y = e^{5x}$, where $D = \frac{d}{dx}$. (12) [CO3]

c) A body executes damped forced vibrations given by the equation (13) [CO3]

$$\frac{d^2x}{dt^2} + 2k \frac{dx}{dt} + b^2x = e^{-kt} \sin \omega t. \quad \text{Solve the D.E for both the cases when } \omega^2 \neq b^2 - k^2 \text{ and when } \omega^2 = b^2 - k^2.$$

8. a) Solve completely the equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$, representing the vibration of a string of (17) [CO3]

length l ; fixed at both ends, given that $u(0, t) = 0$, $u(l, t) = 0$, $u(x, 0) = f(x)$, and

$$\frac{\partial}{\partial t} u(x, 0) = 0, \quad 0 < x < l.$$

b) Solve the D.E $5x^2y'' + x(x+1)y' - y = 0$ using Frobenius method. (18) [CO4]