

Mawlana Bhashani Science and Technology University
 Department of Information and Communication Technology
 2nd Year 2nd Semester BSc (Engg.) Final Examination 2022
 Course Title: Computer-based Numerical Methods
 Course Code: ICT 2203

Marks: 70
Time: 3 hours

Answer any 05 (FIVE). Maintain sequence while answering questions

1. (a) 'Numerical methods are necessary for engineers' – Justify the statement. 4
 (b) How do we obtain a real root of a non-linear equation using Secant method? 10
 Explain graphically and hence deduce the iteration formula.
2. (a) Briefly discuss the method of false position. 4
 (b) Determine the real root of $x^{3.5} = 80$, (a) analytically and (b) with the false-position method to within $\epsilon_s = 2.5\%$. Use initial guesses of 2 and 5. 6
 (c) The irrational number e can be approximated by applying Newton's method to solve the nonlinear equation $f(x) = \ln x - 1 = 0$. What is the Newton iteration formula? 4
3. (a) Write pseudo-code to find the real root of a given equation by Secant method. 6
 (b) Use the Secant method to estimate the root of $f(x) = e^{-x} - x$, employing an initial guess of $x_0 = 0$ and $\epsilon_s = 0.5\%$. 8
4. (a) Write an algorithm to implement the Grass-Seidal method. 7
 (b) Solve the following system by using the Gauss-Seidal method consider less than 1% error 7

$$\begin{cases} 3x_1 - 0.1x_2 - 0.2x_3 = 7.85 \\ 0.1x_1 + 7x_2 - 0.3x_3 = -19.3 \\ 0.3x_1 - 0.2x_2 - 10x_3 = 71.4 \end{cases}$$

5. (a) Write an algorithm to complete Largrange's interpolation. 7
 (b) A table of x vs $f(x)$ is given below. Find the value of $f(x)$ at $x = 4$. 7

x	1.5	3	6
$f(x)$	-0.25	2	20

6. (a) Briefly discuss the Simpson's rule. 7
 (b) Use zero through fourth-order Taylor series expansions to approximate the 7
 function $f(x) = -0.1x^4 - 0.15x^3 - 0.5x^2 + 1.2$ from $x_l = 0$ with $h = 0.1$. That is,
 predict the function's value at $x_{l+1} = 0.1$.

7. (a) What is numerical differentiation? Derive the five-point central difference 7
 formula

$$f'(x) = \frac{-f(x+2h) + 8f(x+h) - 8f(x-h) + f(x-2h)}{12h}$$

- (b) The table below gives the values of distance travelled by a car at various time 7
 intervals during the initial running

Time, t(s)	5	6	7	8	9
Distance travelled, s(t) in km	10.0	14.5	19.5	25.5	32

Estimate velocity at time $t = 7$ and $t = 9$.

8. (a) How do you fit a polynomial function? 7
 (b) Fit a second order polynomial to the data in the table below: 7

x	1.0	2.0	3.0	4.0
y	6.0	11.0	18.0	27.0

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2nd Year 1st Semester B.Sc. (Engg.) Final Examination 2022

Course Title: Digital Logic Design
Marks: 70

Course Code: ICT-2103
Time: 3 Hours

Answer any 5 (Five) from the following 8 (Eight) questions

1. a) What is Digital System? 2
b) Explain the different number systems. 4
c) Why Gray code is preferable than others, explain with example. 4
d) What is the largest binary number that can be expressed with 7 bits? What are the equivalent decimal and hexadecimal numbers? 4
2. a) Find the 9's and 10's complements of the following binary numbers: i) 10000000 ii) 011101110. 5
b) Express the following numbers in decimal: i) $(10110.0101)_2$ ii) $(26.24)_8$ iii) $(16.5)_{16}$ 5
c) Design an OR circuit using Transistors. 4
3. a) Show that a full subtractor can be constructed with two half-subtractors and an OR gate. 6
b) Express the Boolean function $F = AB + \overline{A}C$ in a product of max term form. 4
c) State and Explain the De Morgan's Theorem. 4
4. a) Show that the dual exclusive OR is equal to its complement. 4
b) Convert the following logic function into product of minterms:
 $F(A, B, C, D) = C'D + ABC' + A'B'D + ABD'$ 4
c) Simplify the following equation using K maps: 6
$$Y = \sum M(1, 3, 7, 11, 15) + d(5, 9, 13)$$
5. a) Simplify and implement the following SOP function using NOR gates 4
$$F(A, B, C, D) = \sum m(0, 1, 4, 5, 10, 11, 14, 15)$$

b) What is don't care condition? How don't care helps to minimize the Boolean expression? 4
c) Give the implementation circuit of 3 to 8 line decoder. 6
6. a) Compare sequential circuits and combinational circuits. 2
b) Show the logic diagram characteristic table and characteristic equation of JK flip-flop. 6
c) Implement the following Boolean function with an 8x1 multiplexer. 6
$$F(A, B, C, D) = \sum (0, 3, 5, 6, 8, 9, 14, 15)$$
7. a) Design a seven segment display which display from 0 to 9. 8
b) Design a synchronous counter with counting sequence 0, 3, 5, 7, 6, 0 using J-K flip-flop. 6
8. a) How many 128x8 RAM chips are needed to provide a memory capacity of 2048 bytes? 3
b) Explain the operation of a Johnson counter. 6
c) What is meant by size and capacity of a Memory? Explain the different types of memory. 5

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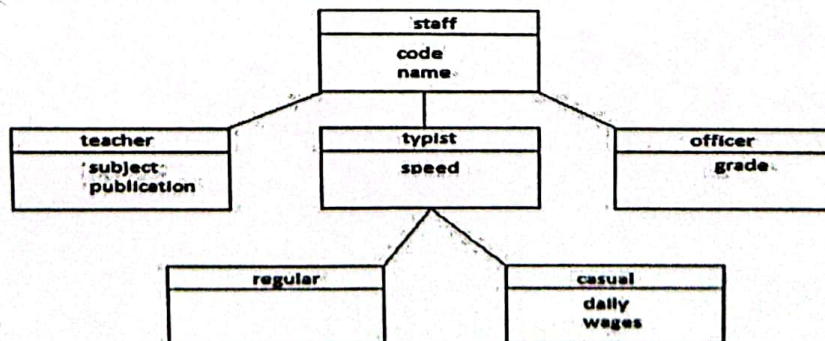
2nd Year 1st Semester B.Sc. (Engg.) Final Examination 2022

Course Title: Object Oriented Programming with Java
Marks: 70

Course Code: ICT-2105
Time: 3 Hours

Answer any 5 (Five) from the following 8 (Eight) questions

1. a) Briefly discuss the following terms: [4]
 - i. Java Virtual Machine (JVM)
 - ii. Java Runtime Environment (JRE)
 - iii. Java Development Kit (JDK).
- b) Define encapsulation. Write down the principal advantages of Object Oriented Programming (OOP). [5]
- c) Write down a java program to check whether the given number is positive or negative. [5]
2. a) Define a constructor. How do you overload a constructor? [4]
- b) What are various access specifiers in Java? List out the behavior of each of them. [4]
- c) Create a class called *Employee* that includes three pieces of information as instance variables—a first name (String), a last name (String) and a monthly salary (Double). Your class should have a constructor that initializes the three instance variables. Provide a set and a get method for each instance variable. [6]
 - i. If the monthly salary is not positive, set it to 0.0.
 - ii. Write a test application named *EmployeeTest* that demonstrates class *Employee*'s capabilities.
 - iii. Create two *Employee* objects and display each object's yearly salary. Then give each *Employee* a 10% raise and display each *Employee*'s yearly salary again.
3. a) Briefly explain static members of the class with suitable examples. [4]
- b) Differentiate between method overloading and method overriding. [5]
- c) What is the mechanism of which a call to an overridden method is resolved at runtime? Illustrate with an example. [5]
4. a) Define inheritance. Explain about multiple inheritance with suitable example. [4]
- b) Discuss the behavior of constructors when there is a multilevel inheritance. Give appropriate code to illustrate the process. [4]
- c) An educational institute wishes to maintain a database of its employees. The database is divided into a number of classes whose hierarchical relationships are shown in the diagram. The diagram also shows the minimum information required for each class. Specify all the classes and define methods to create the database and retrieve individual information as and when required. [6]



Develop a Java program for this scenario and ZIP all the classes into a single file.

5. a) What is exception? How it is handled? Explain with suitable example. [4]
- b) How do you create your own exception class? Explain with a program. [5]
- c) Write a Java program to illustrate the working of finally block when an exception occurs in try block but is not handled in the catch block. [5]

6. a) How do you define variables inside interface? List out the characteristics of such variables. [4]
- b) What do you mean by a package? How do you use it in a Java program? Explain with a program. [5]
- c) Write a Java program that uses multithreading to print out the numbers from 1 to 100, with each thread printing out only odd or even numbers. [5]

- a) Differentiate between abstract base class and an interface. [4]
- b) Mention and explain the uses of super and final keyword in Java. Explain with a code snippet. [5]
- c) Write a Java program to find the maximum and minimum value of an array. [5]

8. a) Define JSP. What are the advantages of JSP over Servlet? [4]
- b) Explain the steps to create a Servlet in java programming language. [5]
- c) Write down a simple java program to read and write a text file named 'ict.txt'. [5]



Mawlana Bhashani Science and Technology University

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2nd Year 2nd Semester BSc (Engg.) Final Examination – 2022

Course Title: Database Management System

Course Code: ICT 2207

Marks: 70

Time: 3 hours

Answer any 05 (FIVE). Maintain sequence while answering questions

1. (a) What is data and information? Describe the advantages of Database Management System (DBMS) over the conventional file processing systems. 5
- (b) What is DBMS? Describe different types of DBMS languages. 5
- (c) What do you understand by Database Instance and Schema? Can Database Schema ever change? Explain your answer. 4

2. (a) What is attribute? Describe different types of attributes used in database systems. 4
- (b) "All super keys are candidate keys, but all candidate keys are not super keys" – Justify your answer with appropriate examples. 3
- (c) The Registrar Office of the Mawlana Bhashani Science and Technology University would like to maintain data about the following entities: 7
 - i. Courses including number, title, credit, syllabus and prerequisites.
 - ii. Courses offering including course_number, year, semester, instructor, timings and classroom.
 - iii. Students including id_number, name, department and designation.

Now the Registrar Office expects that the students of the ICT Department will design an E-R diagram. Your job is to construct an E-R diagram for the Registrar Office. Write down all the assumptions that you make about the mapping constraints.

3. (a) Explain *Specialization*, *Generalization* and *Aggregation* with appropriate examples. 3
- (b) What is relational algebra? Briefly explain the select operation with relevant examples. 3
- (c) Consider the following banking database BANK where the primary keys are underlined: 8
 - branch (branch-name, branch-city, assests)
 - customer (customer-name, customer-street, customer-city)
 - loan (loan-number, branch-name, amount)
 - borrow (customer-name, loan-number)
 - account (account-number, branch-name, balance)
 - depositor (customer-name, account-number)
 - employee (employee-name, street, city)Give an expression in the relational algebra to express each of the following queries:
 - i. Find the names of all customers who have a loan, an account, or both, from the bank.
 - ii. Find the names of all customers who have a loan at the Santosh branch.
 - iii. Find the names of all employees who live in the same city and on the same street as do their managers.
 - iv. Find the loan number for each loan of an amount greater than 12,000/-.

manger (employee - name, manager name)

4. (a) Suppose that we have relation **marks** (**ID**, **score**) and we wish to assign grades to students base on the score as follows:
 grade F if $\text{score} < 40$, grade C if $40 \leq \text{score} < 60$, grade B if $60 \leq \text{score} < 80$, and grade A if $80 \leq \text{score}$. Write SQL queries to do the following:
 i. Write the statement(s) to form a relational **mark_grade**.
 ii. Display the grade for each student, based on the **marks** relation.
 iii. Find the number of students with each grade.
 (b) Explain how the outer join operations are too different than the natural join.
 (c) What are the integrity constraints? Why are those important?

5. (a) Define functional dependency. Describe the following functional dependency with appropriate examples:
 i. Trivial Functional Dependency
 ii. Non-trivial Functional Dependency
 iii. Multivalued Dependency
 iv. Transitive Dependency

(b)

ID	Name	Loan	Deposit
1	Anik	1000	500
2	Alex	1500	700
3	Abir	1700	300
4	Asad	1900	200
5	John	1100	1100
6	Anik	00	600

Consider the relation in the defined table and determine the following:

- i. The functional dependency among the attributes.
 ii. Determine the closure set $F^+(\text{ID})$.
6. (a) What is normalization? What are the roles of normalization in good DB design?
 (b) List the physical storage media available on the computers you use routinely. Give the speed with which data can be accessed on each medium.
 (c) Define trigger. Explain its importance in database systems with an example.
7. (a) What is indexing? Describe about dense sparse indexing.
 (b) What is hashing? Explain different types of hashing.
 (c) Suppose you are given with the following information:
 Number of records = 30 000, block size = 1024 bytes, Strategy = Unspanned,
 Record size = 100 bytes, Key size = 6 bytes, pointer size = 9 bytes.
 Find the average number of block access with or without indexing.
8. (a) What do you understand by RAID? Describe different RAID levels with appropriate diagrams.
 (b) Briefly explain the factors that should be considered for choosing a RAID level.

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2nd Year 1st Semester B.Sc. (Engg.) Final Examination 2022

Course Title: Differential Equations and Vector Calculus
Marks: 70

Course Code: ICT-2109
Time: 3 Hours

Answer any 5 (Five) from the following 8 (Eight) questions

1. (a) Define linear and non-linear differential equation. Find the corresponding differential equation to the family of curves $c(y+c)^2 = x^3$; where c is arbitrary constant. Also identify it. 6
(b) Prove that if $M(x,y)dx + N(x,y)dy = 0$ is a homogeneous differential equation, then the change of variable $y = vx$ transform the homogeneous equation into a separable equation in the variable v and x . 4
(c) Identify and solve the initial value problem $(y + \sqrt{x^2 + y^2})dx - xdy = 0$ $y(1) = 0$. 4
2. (a) Define exact differential equation. Verify the exactness and solve the differential equation $(2x \cos y + 3x^2 y)dx + (x^3 - x^2 \sin y - y)dy = 0$ by any suitable method. 5
(b) Define integrating factor. Show that the equation $(2x^2 + y)dx + (x^2 y - x)dy = 0$ is not exact. Find the integrating factor of the form x^n and solve it. 5
(c) Identify and solve the equation $(x^2 + 1)y' + 4xy = x$. 4
3. (a) Define linear differential equations with example. Show that $\frac{1}{D-\alpha} X = e^{\alpha x} \cdot \frac{1}{D} (e^{-\alpha x} X)$, where X is a function of x . 4
(b) Solve the following higher order differential equations: 10
(i) $\frac{d^4 y}{dx^4} - y = x \sin x$; (ii) $(D^2 - 2D + 1)y = x^3 e^{3x}$; (iii) $(D^5 - D)y = 12e^x + 8 \sin x - 2x$.
4. (a) Formulate a partial differential equation by eliminating the arbitrary function ϕ from the equation $\phi(x^2 + y^2 + z^2, lx + my + nz) = 0$. Examine whether the partial differential equation is linear or non-linear. Also, find its order and degree. 5
(b) Find the solution of the one-dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$ with the boundary conditions $u(0,t) = u(l,t) = 0$, $u(x,0) = f(x)$ $\left(\frac{\partial u}{\partial t} \right)_{t=0} = g(x)$. 9
5. (a) Evaluate grad f , if $f(x, y, z) = x^2 + xy \sin y + xz^3$. 7
(b) Show that $f = (1/r)$ is a solution to Laplace's equation $\nabla^2 f = 0$. 7
6. (a) Define linearly dependent and linearly independent vectors. Examine whether the vectors $5i + 6j + 7k$, $7i - 8j + 9k$, $3i + 20j + 5k$ are linearly independent or dependent. 6
(b) Find the projection of the vector $2i - 3j + 6k$ on the vector $i + 2j + 2k$. 4
(c) Find the constant a such that the vectors $2i - j + k$, $i + 2j - 3k$ and $3i + aj + 5k$ are coplanar. 4
7. (a) Define gradient and curl of a vector? Mention physical significance of curl. 4
(b) What is directional derivative? Find the directional derivative of $\phi = x^2 yz + 4xz^2$ at the point $(1, -2, -1)$ in the direction $2i - j - 2k$. 5
(c) Suppose $A = x^2 yi - 2xzj + 2yzk$. Find curl curl A at the point $(1, -2, -1)$. 5
8. (a) Define line integral. Suppose a force field is given by $\vec{F} = (2x - y + z)i + (x + y - z^2)j + (3x - 2y + 4z)k$. Find the work done in moving a particle once around a circle C in the xy plane with its centre at the origin and a radius of 3. 5
(b) A particle moves along the curve $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$, where t is the time. Find the components of its velocity and acceleration at time $t = 1$ in the direction $i - 3j + 2k$. 5
(c) Find the volume of the region common to the intersecting cylinders $x^2 + y^2 = a^2$ and $x^2 + z^2 = a^2$. 4