Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering L-2, Term-II, Exam. 2023

Course No: CSE-223
Course Title: Digital Signal Processing
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) What is signal? With necessary figure, distinguish between Longitudinal wave and Transverse wave. 06

Q.1(b) Write down the characteristic properties of continuous-time sinusoidal and discrete-time sinusoidal signals. 06

Q.1(c) Consider a sinusoidal signal $x(n) = \sin(\omega_0 n)$. Draw the digital signals for which the values of ω_0 are $\frac{\pi}{8}, \frac{\pi}{4}, \frac{\pi}{2}$ and π. 12

Q.1(d) What is folding frequency? Graphically represent the relationship between the continuous-time and discrete-time frequency variables in the case of periodic sampling. Using that relationship, briefly explain how alias frequencies can be identified. 11

Q.2(a) Consider the analog signal $x_a(t) = 10\cos 300\pi t$ 12

i) Determine the minimum sampling rate required to avoid aliasing.
ii) Suppose that the signal is sampled at $F_s = 100$Hz. What is the discrete time signal obtained after sampling?
iii) What is the frequency $0 < F < F_s/2$ of a sinusoidal that yields samples identical to those obtained in part (ii)?

Q.2(b) An analog signal contains frequencies up to 10 KHz 13

i) What range of sampling frequencies allow exact reconstruction of this signal from its samples?
ii) Suppose that we sample this signal with a sampling frequency $F_s = 8$KHz. Examine what happens to the frequency $F_1 = 5$KHz.
iii) Repeat part (ii) for a frequency $F_2 = 9$KHz.

Q.2(c) Using the basic building blocks, sketch the block diagram representation of the discrete time signal system described by the input-output relation 10

$$y(n) = \frac{1}{4}y(n-1) + \frac{1}{2}x(n) + \frac{1}{2}x(n-1)$$

where $x(n)$ is the input and $y(n)$ is the output of the system.

Q.3(a) Name four alternative representations of discrete-time signals. Use all of these techniques to represent each of the following signals: 14
Unit Impulse, Unit Step, and Unit Ramp.

Q.3(b) In the case of discrete-time signals, distinguish between the following: 12

i) Energy signals and power signals
ii) Symmetric signals and antisymmetric signals.

Q.3(c) Determine the response of the following systems of the input signal 09

$$x(n) = \begin{cases} n, & -3 \le n \le 3 \\ 0, & otherwise \end{cases}$$

i) $y(n) = 2x(n) + x(n-1)$
ii) $y(n) = \frac{1}{3}[x(n+1) + x(n) + x(n-1)]$
iii) $y(n) = max\{x(n+1), x(n), x(n-1)\}$

Q.4(a) A discrete-time signal, $x(n)$ is shown in Fig. 4(a). Sketch and label carefully each of the following signals: 08

i) $x(n-2)$
ii) $x(4-n)$
iii) $x(n)u(2-n)$
iv) $x(n^2)$

Q.4(b) Compute and sketch the convolution $y(n) = x(n) * h(n)$ of the following signals: 14

i) $x(n) = \{1, 2, 0, 2, 1\}, h(n) = \{1, -2, -3, 4\}$

ii) $x(n) = \{0, 1, -2, 3, -4\}, h(n) = \left\{\frac{1}{2}, \frac{1}{2}, 1, \frac{1}{2}\right\}$

Q.4(c) Determine the crosscorrelation sequence $r_{xy}(l)$ of the sequences 13

$$x(n) = \{\ldots, 0, 0, -1, 3, 7, 1, 2, -3, 0, 0, \ldots\}$$

$$y(n) = \{\ldots, 0, 0, -1, 2, -2, 4, 1, -2, 0, 0, \ldots\}$$

Section-B

Q.5(a) What do you know about direct z-transform and inverse z-transform? Determine the z-transform of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$ 11

Q.5(b) Distinguish between bilateral and unilateral z-transform. Determine the z-transform and the ROC of the signal $x(n) = [3(2^n) - 4(3^n)]u(n)$. 12

Q.5(c) Use the z-transform to compute the convolution $x(n)$ of the signals: 12

$$x_1(n) = \{1, -2, 1\}$$

$$x_2(n) = \begin{cases} 1, & 0 \le n \le 5 \\ 0, & elsewhere \end{cases}$$

Q.6(a) Briefly discuss on the relationship of the Fourier transform and z-transform. 07

Q.6(b) Determine the output sequence of the system with impulse response 07

$$h(n) = \left(\frac{1}{2}\right)^n u(n)$$

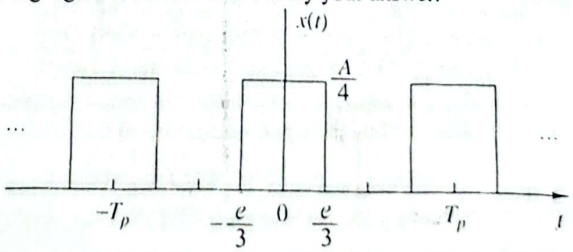
when the input is the exponential sequence

$$x(n) = Ae^{j\pi\frac{n}{2}}, -\infty < n < \infty$$

Q.6(c) Write the difference between FIR and IIR. Explain the steps of Digital filter design. 12

Q.6(d) Briefly describe window-based FIR filter design. 09

Q.7(a) Determine the power density spectrum of the rectangular pulse train signal. Also state that the following signal is even or odd. Justify your answer. 12



Q.7(b) Distinguish between real DFT and complex DFT. With necessary figure explain how the FFT works. Explain all the steps. 15

Q.7(c) Determine the response of the system to the input signal 08

$$x(n) = 10 - 5\sin\frac{\pi}{2}n + 20\cos\pi n, -\infty < n < \infty$$

Q.8(a) Define Comb filter and Notch filter. 06

Q.8(b) A discrete time signal is given below: 17

$$x(n) = \{0, 4, 3, 5\}$$

Compute the DFT of the signal by using the correlation.

Q.8(c) What do you know about the basis function? Illustrate the sine and cosine basis function for an $N = 16$ point DFT and frequency $k = 2, 4, 5, 12$. 12

END

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering L-2, Term-II, Exam. 2023

Course No: CSE-251
Course Title: Database Management Systems
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) Discuss the role of indexing in a database. How do they improve query performance and what are the trade-offs? 10

Q.1(b) "Thomas Write Rule allows schedules that are not conflict serializable but are nevertheless correct" – How? Explain with proper example. 10

Q.1(c) In a software development company, employees work in a hierarchical structure where each employee has a unique ID, name and job title and some employees act as managers, supervising others. Each employee may report to only one manager, but a manager can oversee multiple employees. The company also runs several projects, each with a unique ID, name and budget. Employees can work on multiple projects, and each project involves multiple employees performing role like Developer, Tester or Project Manager. Additionally, every project has one designated manager responsible for overseeing its execution. They should track the start and end dates of employees' involvement in projects and their specific roles. 15

Draw an ER diagram for the above scenario showing cardinalities for each of the relations.

Q.2(a) A ternary relationship is shown in Fig. 2(a). 12

i) Convert the ternary relationship into binary relationships.

ii) What are the advantages and disadvantages of converting a ternary relationship into binary relationship?

iii) *How would you ensure data integrity after the conversion?*

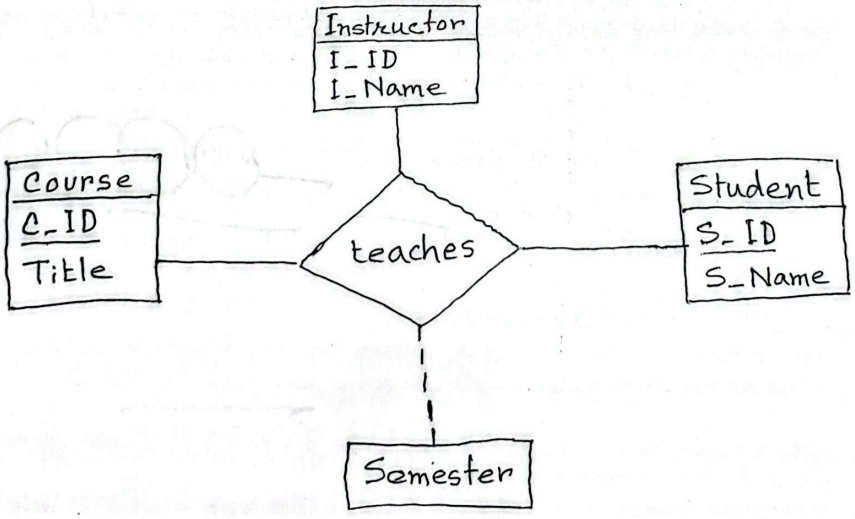


Fig. 2(a)

Q.2(b) Answer the following questions using ER Diagram: 10

i) Give two examples of Aggregation.

ii) Give one example for each: Total specialization, Partial generalization, Disjoint specialization.

Q.2(c) See Fig. 2(c) and answer the following questions: 13

i) Reduce the ER diagram to relational model.

ii) What are the advantages of using relational model over ER model?

(Please find the figure on the next page)

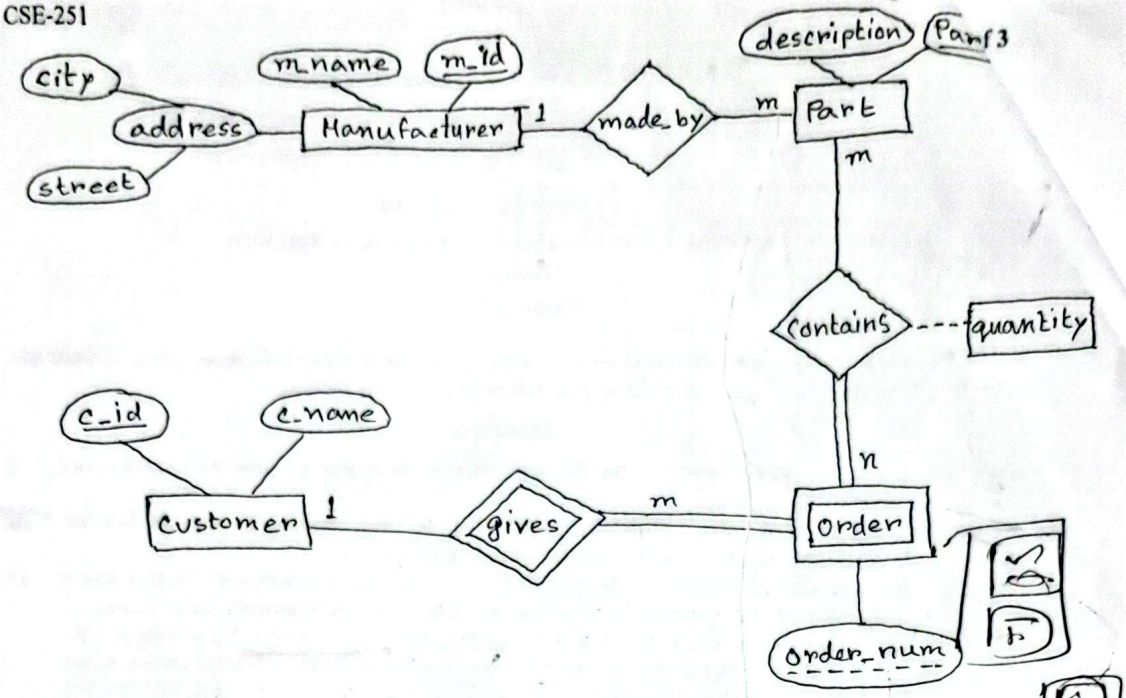


Fig. 2(c)

Q.3(a) Identify anomalies in the given relation table. Normalize the table up-to 3NF. 13

S_ID	S_Name	S_Address	Contact_no	Clg_Name	Clg_Address
1001	XYZ	Dhaka	9806, 9804	Col_1	Ctg
1002	ABC	Ctg	9802, 9805	Col_2	Dhaka
1003	CDE	Sylhet	9806, 9888	Col_2	Dhaka
1004	EMF	Dhaka	9854	Col_3	Khulna

Q.3(b) Suppose that we decompose the schema 11

$R = (A, B, C, D)$ into $R_1 = (A, B, C)$ and $R_2 = (B, D, E)$.

Show whether this decomposition is lossy or lossless if the following set F of functional dependencies holds: $A \rightarrow BC$

$CD \rightarrow E$

$B \rightarrow D$

$E \rightarrow A$

Q.3(c) Consider a relation Faculty with relational schema Faculty(FID, FName, Dept, Salary). 11
Here, FID stores the values 1, 2, 3, …, n as faculty identification numbers. The following query is the most frequent one:

```
Select *
From Faculty
Where FID > V1 and FID < V2;
```

Assume that Faculty does not have any indexes. You need to create necessary indexes. Which index is best suited for executing the above query efficiently? Explain.

Q.4(a) What would be the occupancy of each leaf node of a B+ tree be if index entries are sorted? Explain the scenario with example. 10

Q.4(b) Differentiate between B+ tree and B tree. Explain with example, what type of hashing is suitable for a database that grows and shrinks in size. 10

Q.4(c) Construct a B+ tree for the following set of key values: 15

(2, 3, 5, 7, 11, 17, 23, 29, 19, 31)

Assume that the tree is initially empty. Construct the B+ tree for number of pointers in one node is equal to four.

Section-B

Q.5(a) Differentiate between data and information. Assume that two customers are trying to buy the only remaining ticket of 'Subono Express'. What component of a database system will handle this situation and how? 10

Q.5(b) Differentiate between different levels of abstraction with proper example. 05

Q.5(c) How does the query processor of a database engine, processes the query to obtain the desired results? 10

Q.5(d) Explain the concept of two-tier and three-tier architecture of database applications. 10

Q.6(a) Database system implementers have paid much more attention to the ACID properties than have file system implementers. Explain the logical reason behind this choice. 05

Q.6(b) Consider the following tables already created in a database. 15

person (nid, name, address)
car (license, year, model)
accident'(report_number, date, location)

Now, write DDL commands to create another table named 'Participation', considering there is n-ary relation between person, car and accident. Also, modify the car table to include another attribute named 'accident count' without deleting the original table.

Q.6(c) Consider there is a database system for keeping track of all the players and games of 'Squid Game'. Three relations are given as follows – 15

Players (pid, name, age, debt)
Games (gid, gname, round)
Plays (pid, gid, status)

Write the algebraic expression for the following statements –

i) Find all players who participated in the "Red Light, Green Light" game.
ii) Find the debt of the players who lost in the second round.
iii) List the names of players who survived all rounds.

Q.7(a) Suppose a user wants to grant 'select' access on a relation to another user. Why should the user include/not include the clause 'granted by current role' in the grant statement? 07

Q.7(b) What are triggers in *SQL*? When should we use/not use them? Give a basic template for creating a trigger. 10

Q.7(c) Suppose, the following relation are given as a part of a database – 18

agency (aid, aname, acity)
flight (fid, fdate, time, src, dest)
booking (pid, fid, aid, fdate)
passenger (pid, pname, pgender, pcity)

Now, write SQL statements for the following queries –

i) Find the flight numbers for passenger with pid 'XYZ' for flights to 'CTG' before 2025.
ii) Find the number of passengers for each gender who have bookings on at least one flight.
iii) Find the details of all female passengers who are associated with US-Bangla Airlines.

Q.8(a) Suppose a transaction is written in *C* with embedded *SQL*, and about 80% of the time is spent in the *SQL* code, with the remaining 20% spent in *C* code. How much speed up can one hope to attain if parallelism is used only for the *SQL* code? Explain. 10

Q.8(b) Differentiate between the followings – 10

i) Homogeneous vs Heterogeneous distributed database.
ii) Shared memory vs Shared nothing.
iii) Local vs Global transaction.

Q.8(c) Consider the following schema – 15

suppliers (sid, sname, address)
parts (pid, pname, color)
catalog (sid, pid, cost)

Now, write *SQL* statements for the following queries –

i) Find the address of suppliers who supply red or green parts.
ii) Find the average cost of blue parts supplied by every supplier.
iii) Find the total number of suppliers that supplies parts at the rate of below 1000Tk.

END

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering L-2, Term-II, Exam. 2023

Course No: CSE-243
Course Title: Algorithm Design and Analysis
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) What is an algorithm? What do you mean by finiteness, completeness, and correctness of an algorithm? Write down the steps of an algorithm development process. 10

Q.1(b) Define Big Oh (O), Little Oh (o), Big Omega (Ω), Little Omega (ω), and Big Theta (Θ) notations. Explain with a graph. 10

Q.1(c) Define recursive algorithm. Explain Tower of Hanoi problem. 15

Q.2(a) Let $T(n) = \frac{1}{2}n^2 + 3n$. Which of the following statements are true and why? 07

i) $T(n) = O(n)$
ii) $T(n) = \Omega(n)$
iii) $T(n) = \Theta(n^2)$
iv) $T(n) = O(n^3)$

Q.2(b) Solve the recursive relations given below using recursion tree method and master method respectively: 20

i) $T(n) = \begin{cases} C & if\ n = 1 \\ 2T\left(\frac{n}{2}\right) + C_n & if\ n > 1 \end{cases}$

ii) $T(n) = 8T\left(\frac{n}{2}\right) + n^2$

Q.2(c) Prove that binary search follows divide and conquer method. 08

Q.3(a) Distinguish between (i) Greedy and Dynamic technique (ii) Divide and conquer and Dynamic technique. 12

Q.3(b) Define feasible solution and optimal solution. How does the choice of pivot element impact in average runtime of quick sort algorithm? 12

Q.3(c) Strassen matrix multiplication algorithm requires $O(n^{2.8})$ time whereas classical algorithm requires $O(n^3)$ time. How does Strassen's able to reduce the time requirement from $O(n^3)$ to $O(n^{2.8})$? 11

Q.4(a) Why do stack and queue data structure appropriate for DFS and BFS respectively? Why time complexity for BFS is $O(V+E)$ instead of $O(V \times E)$? 10

Q.4(b) Suppose, a Bangladeshi bank has the following coins/notes available: 10

$$\{1, 2, 5, 10, 20, 50, 100, 500, 1000\}$$

Now, propose an algorithm using greedy approach to solve the coin change problem. Calculate the time complexity of your algorithm.

Q.4(c) What are the differences between fractional and 0/1 Knapsack problem? Propose different algorithms to solve these problems. 15

Section-B

Q.5(a) What is MST (Minimum Spanning Tree)? What are the application of MST? Find the MST for the graph given in Fig. 5(a) using Prim's algorithm. 15

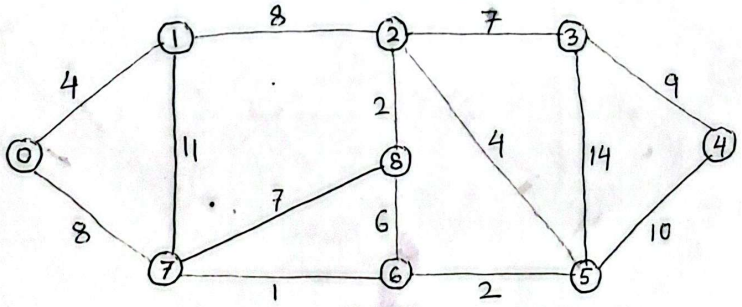


Fig. 5(a)

Q.5(b) Write down the differences between Adjacency Matrix and Adjacency List. Which type of data structure should we use while working with a dense graph? 10

Q.5(c) Write an algorithm to find the number of connected components of a given graph. 10

Q.6(a) What do you mean by Relaxation while applying any shortest path algorithm? What are the advantages of using Bellman-Ford algorithm over Dijkstra's algorithm? 10

Q.6(b) Apply the Dijkstra algorithm to find the shortest distance from source A to all other vertices of the given graph in Fig. 6(b). 10

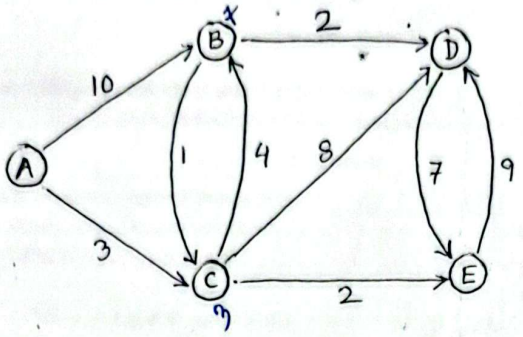


Fig. 6(b)

Q.6(c) Consider a Knapsack problem with $n = 4$ items. The value and size of each item is as follows: 15

$v_1 = 3$ $w_1 = 4$
$v_2 = 2$ $w_2 = 3$
$v_3 = 4$ $w_3 = 2$
$v_4 = 4$ $w_4 = 3$

The capacity $w = 7$. Find the optimal value and optimal solution. Also show the recurrence to solve the problem using dynamic programming.

Q.7(a) Define a flow network. What is an augmentation path in a flow network? Explain with an appropriate example. 06

Q.7(b) For the flow network shown in Fig. 7(b), find the value of the maximum flow by drawing residual networks in each step. Finally, draw the maximum flow network. 15

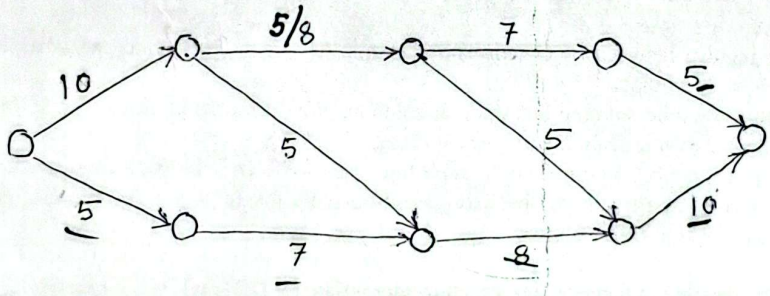


Fig. 7(b)

Q.7(c) Suppose, $X \in NP - Complete$. Prove that, $X \in P$ if and only if $P = NP$. 08

Q.7(d) Differentiate between sequential and parallel algorithms. 06

Q.8(a) What is negative cycle in a graph? How will you detect a negative cycle using Bellman-Ford algorithm? 09

Q.8(b) Why $P \neq NP$? Justify: what would have been if $N = NP$. 06

Q.8(c) Apply Ford Fulkerson algorithm to find the maximum flow between the source to the sink in Fig. 8(c). 20

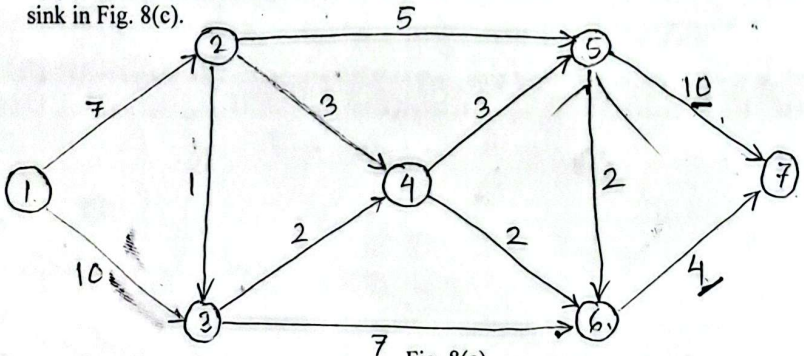


Fig. 8(c)

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Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B.Sc. Engineering L-2, Term II Exam. 2023

Course No: Math-243
Course Title: Vector Calculus, Linear Algebra and Complex Variable
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a) Define analytic function and harmonic function with example. 06

Q.1(b) Prove that the function 18

$$f(z) = \frac{x^3(1+c') - y^3(1-c')}{x^2+y^2}, z \neq 0$$
$$= 0; \quad z = 0$$

satisfied Cauchy-Riemann equations at the origin but $f(z)$ is not analytic there.

Q.1(c) Find the Laurent's expansion of, 11

$f(z) = \frac{1}{(z+1)(z+3)}$ in the region $0 < |z+1| < 2$

Q.2(a) State the Cauchy's integral theorem and hence evaluate 15

$$\oint_C \frac{e^{2z}}{(z-1)(z-2)} dz$$

where c is the circle $|z| = 3$.

Q.2(b) Evaluate $\int_0^{2\pi} \frac{d\theta}{5+4\cos\theta}$ by employing the method of contour integration. 20

Q.3(a) Define gradient of a differentiable scalar field. Find a, b, c so that 10

$$\vec{V} = (x + 2y + az)\hat{\imath} + (bx - 3y - z)\hat{\jmath} + (4x + cy + 2z)\hat{k}$$

is irrotational.

Q.3(b) Show that $\vec{\nabla}\Phi$ is a vector perpendicular to the surface $\Phi(x, y, z) = c$, where c is a constant. 10

Q.3(c) Show that $\vec{F} = (2xy + z^3)\hat{\imath} + x^2\hat{\jmath} + 3xz^2\hat{k}$ is a conservative force field. Hence find the scalar potential. 15

Q.4(a) Find the work done in moving a particle around a circle 'C' in the xy plane, if the circle has centre at the origin and radius 3 and if the force field is given by 17

$$\vec{F} = (2x - y + z)\hat{\imath} + (x + y - z^2)\hat{\jmath} + (3x - 2y + 4z)\hat{k}$$

Q.4(b) Evaluate $\iint_S \bar{A} \cdot \bar{x}\, ds$, where $\bar{A} = z\hat{\imath} + x\hat{\jmath} - 3y^2\hat{k}$ and s is the surface of $x^2 + y^2 = 16$ included in the first octant between $z = 0$ and $z = 5$. 18

Section-B

Q.5(a) Define Orthogonal matrix. Verify whether the matrix 10

$$\begin{bmatrix} \cos\theta & 0 & \sin\theta \\ 0 & 1 & 0 \\ -\sin\theta & 0 & \cos\theta \end{bmatrix}$$

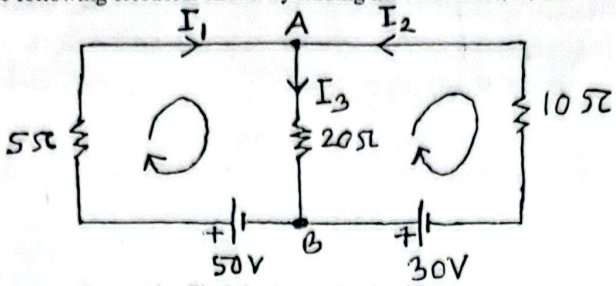
is an orthogonal matrix or not.

Q.5(b) Use elementary row operations to find the inverse of the matrix A, where 12

$$A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$$

Q.5(c) Define rank of a matrix. Find the rank of the matrix $\begin{pmatrix} 1 & 2 & -3 & 1 & 2 \\ 2 & 4 & -4 & 6 & 10 \\ 3 & 6 & -6 & 9 & 13 \end{pmatrix}$. 13

Q.6(a) Analyze the following electrical circuit by finding the currents I_1, I_2, and I_3. 15



Q.6(b) Define spectrum of a matrix. Find the bases for the Eigenspaces corresponding to the Eigenvalues 1 and 2 of the matrix 20

$$A = \begin{pmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{pmatrix}$$

Hence find a matrix that diagonalizes A. Also calculate A^{2025}.

Q.7(a) Discuss how a complete color image created on computer screens can be viewed in terms of n-tuples belonging to the vector space defined on $\mathbb{R}^n$. 05

Q.7(b) Write down the Cauchy-Schwarz inequality for two vectors of $\mathbb{R}^n$. Also find the vector equation of a straight line passing through the points (2024, 1, 2) and (2025, 4, 1). 05

Q.7(c) Define subspace of a vector space. Show that the set 10

$$M_s = \{A: A \text{ is } 2 \times 2 \text{ symmetric matrix}\}$$

forms a vector subspace of the vector space defined on the set

$$M = \{P: P \text{ is a } 2 \times 2 \text{ matrix}\}$$

under the operations scalar multiplication and matrix addition.

Q.7(d) Define spanning set of a vector space. Determine, whether the set 15

$$\left\{\begin{pmatrix} 1 \\ 2 \\ -1 \end{pmatrix}, \begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}, \begin{pmatrix} -1 \\ 4 \\ 3 \end{pmatrix}\right\}$$

Span the vector space defined on $\mathbb{R}^3$.

Q.8(a) *Define linear transformation. When is a linear transformation said to be linear operator?* 07
Which standard matrix can serve as an operator on $\mathbb{R}^2$ to reflect a unit square about the x-axis?

Q.8(b) Define kernel of a linear transformation. Determine the vectors having the kernel 15
property of the linear transformation T: $\mathbb{R}^4 \rightarrow \mathbb{R}^3$ defined by the matrix

$$\begin{pmatrix} 1 & 0 & 4 & -2 \\ 1 & -1 & 3 & 0 \\ 1 & 1 & 5 & -4 \end{pmatrix}$$

Also find the rank of the transformation and dimension of the kernel subspace of T.

Q.8(c) Suppose that T: $\mathbb{R}^2 \rightarrow \mathbb{R}^3$ is a linear transformation defined as: 13

$$T\left(\begin{pmatrix} x \\ y \end{pmatrix}\right) = \begin{pmatrix} y \\ -5x + 13y \\ -7x + 16y \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ -5 & 13 \\ -7 & 16 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix}$$

Find the matrix for transformation T with respect to the bases

$$B = \left\{\begin{pmatrix} 3 \\ 1 \end{pmatrix}, \begin{pmatrix} 5 \\ 2 \end{pmatrix}\right\} \text{ for the } \mathbb{R}^2 \text{ and}$$

$$B' = \left\{\begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix}, \begin{pmatrix} -1 \\ 2 \\ 2 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 2 \end{pmatrix}\right\} \text{ for } \mathbb{R}^3.$$

END

Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering L-2, Term-II, Exam. 2023

Course No: EE-283
Course Title: Electronic Drives and Instrumentation
Marks: 210
Time: 3 Hours

The figure in the right margin indicates full marks. The questions are of equal value. Answer any three questions from each section. Use separate script for each section.

Section-A

Q.1(a)	Explain the construction and working principle of an universal motor.	10
Q.1(b)	Explain the physical significance of producing back EMF in a DC motor.	10
Q.1(c)	A DC series motor operates at 800 rpm with a line current of 100A from 230V mains. Its armature circuit resistance is 0.15Ω and its field resistance 0.1Ω. Find the speed at which the motor runs at a line current of 25A. Assume that the flux at this current is 45 percent of the flux at 100A.	10
Q.1(d)	Show that it is dangerous to start DC series motor without load.	05
Q.2(a)	Discuss the speed control method used in a DC shunt motor.	13
Q.2(b)	A 250V shunt motor has armature current of 50A and runs at 750 rpm. If the flux of motor is reduced by 10% without changing the load torque, find the new speed of the motor.	12
Q.2(c)	State two applications of each of the motors: i) DC shunt motor ii) DC series motor iii) Induction motor iv) Synchronous motor and v) Stepper motor.	10
Q.3(a)	State the functions of components of a practical DC generator.	10
Q.3(b)	Draw and explain the OCC curve of a self-excited DC shunt generator and from the curve define critical resistance.	12
Q.3(c)	Show that the current obtained from a simple loop generator is alternating in nature. Explain how this alternating current can be converted to unidirectional current through the external circuit.	13
Q.4(a)	Prove that the efficiency of a DC generator will be maximum at a condition, variable loss = constant loss.	12
Q.4(b)	A long-shunt compound generator delivers a load current of 50A at 500V and has armature, series field and shunt field resistances of 0.05Ω, 0.03Ω and 250Ω respectively. Calculate the generated EMF and armature current. Allow 1V per brush for contact drop.	10
Q.4(c)	Explain the principle of a variable reluctance stepper motor for 1-phase-ON, 2-phase-ON and half-step operation.	13

Section-B

Q.5(a)	How does a resultant magnetic flux of constant magnitude and constant speed developed when three-phase supply is applied to the stator of Induction motor.	15
Q.5(b)	A 3-phase, 50Hz, 4-pole induction motor has a slip of 0.04 per unit when the output is 20KW. The function loss is 400W. What is the relative speed between the rotating emf and the rotor? What is the rotor circuit copper loss.	12
Q.5(c)	What are the conditions of synchronization of an alternator to connect in parallel with infinite bus bar.	08
Q.6(a)	State the importance of using transformers in generation, transmission and distribution sides.	09
Q.6(b)	Draw phasor diagram of a loaded transformer with i) A resistive load ii) An inductive load and iii) A capacitive load.	12
	Derive the equivalent circuit of a single phase transformer.	11
	What do you mean by all-day efficiency of a transformer?	03

Q.7(a)	What do you mean by transducer? What are the criteria of selecting a good transducer?	09
Q.7(b)	Explain the principle of capacitive transducer. What are the methods of changing capacitance of that transducer?	12
Q.7(c)	Explain the working principle of LVDT. What are the advantages and disadvantages of LVDT?	09
Q.7(d)	Discuss the applications of transducers in industrial automation.	05
Q.8(a)	Write short note on piezo-electricity and piezo-electric transducer.	12
Q.8(b)	Describe principle of photo-voltaic transducer. Draw a simple practical solar panel.	15
Q.8(c)	Draw the vector diagram of a synchronous motor under the following conditions: i) At unity power factor ii) At lagging power factor.	08

END