

**Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-II, Term-II, Exam. 2021**

Course No.: EE-283

Course Title: Electrical Drives and Instrumentation

Time: 3 Hours

Marks: 210

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) | Briefly describe the functions of essential parts of a practical generator. | 10 |
| Q.1(b) | State four conditions for buildup of shunt DC generator. | 08 |
| Q.1(c) | Classify DC generators. | 08 |
| Q.1(d) | A long shunt compound generator delivers a load current of 50 A at 440 V and has armature, series field and shunt field resistances of 0.05Ω , 0.03Ω and 220Ω respectively. Calculate the generated voltage and the armature current. Allow 2 V brush for contact drop. | 09 |
| Q.2(a) | What is hysteresis and hysteresis loss? How you can reduce hysteresis loss. | 10 |
| Q.2(b) | Compare over-compounded, under compounded and flat-compounded DC generator. | 08 |
| Q.2(c) | Draw and explain output characteristic of a DC shunt generator. | 10 |
| Q.2(d) | A short-shunt compound generator delivers a load current of 30A at 220V and has armature, series field and shunt field resistances of 0.05 ohm, 0.03 ohm and 250 ohm, respectively. Calculate the induced emf and the armature current. Allow 1 volt per brush for contact drop. | 07 |
| Q.3(a) | Derive the condition for maximum power developed in DC motor. | 08 |
| Q.3(b) | How back emf produced in DC motor? | 08 |
| Q.3(c) | A 250 volt dc shunt motor has armature resistance of 0.25Ω , on load it takes an armature current of 50A and runs at 750 r.p.m. If the flux of motor is reduced by 10% without changing the load torque, find the new speed of the motor? | 10 |
| Q.3(d) | Define starting torque. Derive the equation of the starting torque of an induction motor. | 09 |
| Q.4(a) | State the motivation of Transformers at generation, transmission and Distribution of electricity. | 10 |
| Q.4(b) | Derive the emf equation of a single-phase transformer. | 08 |
| Q.4(c) | Define all day efficiency of a transformer. | 08 |
| Q.4(d) | Derive and draw the equivalent circuit of a single-phase practical transformer. | 09 |

Section-B

Q.5(a)	Describe the construction and operation of a solar cell.	6 + 6
Q.5(b)	Draw and explain the circuit diagram of a Digital frequency meter.	13
Q.5(c)	Draw and explain the circuit diagram of a ramp type digital voltmeter.	10
Q.6(a)	Define step angle and resolution of a stepper motor.	04
Q.6(b)	Describe the constructional details and operating principle of a variable type reluctance stepper motor with state diagram.	12
Q.6(c)	How does a resultant magnetic flux of constant magnitude and speed develop when three-phase supply is fed to the stator of a three-phase induction motor?	19
Q.7(a)	What are the conditions of synchronization of an alternator to connect in parallel with infinite bus-bar?	08
Q.7(b)	Write down some applications of differential amplifier. Draw the circuit diagram of a FET differential amplifier.	07
Q.7(c)	Draw vector diagram of a loaded Transformer with (i) Resistive load (ii) Inductive load (iii) Capacitive load	15
Q.7(d)	Draw vector diagram of a loaded Alternator with inductive load.	05
Q.8(a)	What are the benefits of stationary armature in an Alternator?	07
Q.8(b)	Write short note on: (i) Pressure transducer with LVDT and Bourdon tube (ii) Photo-electric transducer (iii) Universal machine (iv) Digital Data Acquisition	16
Q.8(c)	What is LVDT? How does linear motion can be converted into electrical signal in LVDT?	12

-The End-

**Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2021**

Course No.: CSE-243

Course Title: Algorithms Design and Analysis

Time: 3 Hours

Marks: 210

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 do you mean by algorithms? State some application areas of algorithms. 5+8 = 13
- Q.1(b)** Distinguish between divide & conquer and dynamic programming techniques. 10
- Q.1(c)** Write short note on Brute force technique. 12
- Q.2(a)** Write the pseudocode for Insertion sort algorithm. Explain insertion sort with appropriate examples. Explain its best case, worst case and average case time complexity. 3*6 = 18
- Q.2(b)** Check whether the following equations are correct or incorrect: 10
- $n^2 / \log n = \theta(n^2)$
 - $n^3 + 10^6 n^2 = \theta(n^3)$
 - $33n^3 + 4n^2 = \Omega(n^3)$
 - $n^2 \log n = \theta(n^2)$
 - $n^3 2^n + 6n^2 3^n = O(n^3 2^n)$
- Q.2(c)** What do you mean by space complexity of an algorithm? 7
- Q.3(a)** Write short note on big oh, big omega and big theta. 15 = 3*5
- Q.3(b)** Given the following jobs, their deadlines and associated profits: 10

Jobs	J1	J2	J3	J4	J5	J6
Deadlines	5	3	3	2	4	2
Profits	200	180	190	300	120	100

- i. Write the optimal schedule that gives maximum profit.
ii. Are all jobs completed in the optimal schedule?
iii. What is the maximum earned profit?
- Q.3(c)** Write the pseudocode for binary search algorithm. Establish the recurrence relation for binary search algorithm. 10

- Q.4(a)** Write the merits and demerits of substitution and master method. 6
Q.4(b) The recurrence relation for binary search is as follows: 7*2 = 14

$$T(n) = \begin{cases} 1 & ; \text{if } n = 1 \\ T\left(\frac{n}{2}\right) + c & ; \text{if } n > 1 \end{cases}$$

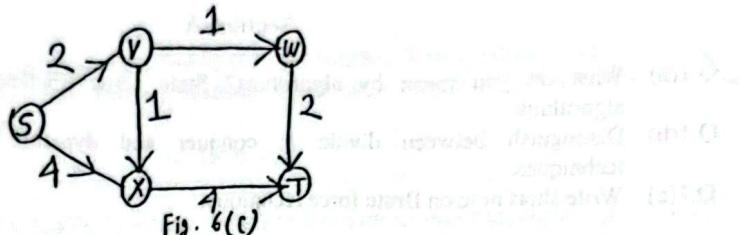
- Solve this relation by using substitution and master method.
Q.4(c) Solve the following recurrence relation by using recursion tree method. 8
 $T(n) = 2T(n/2) + c_n$.
Q.4(d) Explain the worst-case scenario for quicksort algorithm. 7

Section-B

- Q.5(a)** Make an analogy among NP-hard, NP-complete and NP classes of problems 09

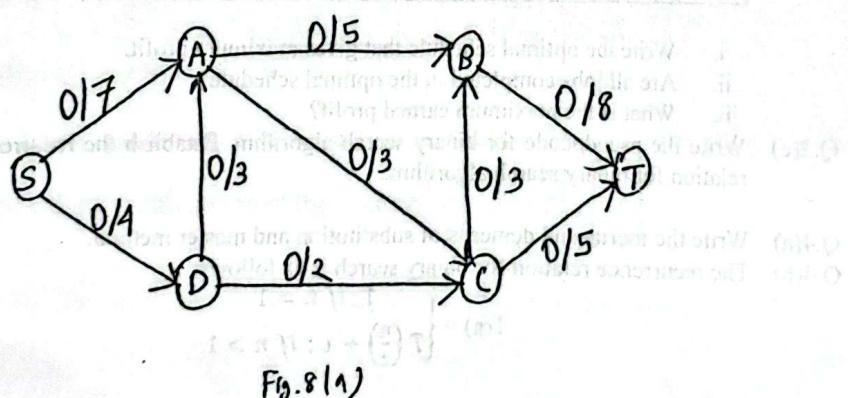
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- in computer science.
- Q.5(b)** Define sub-set sum problem. Write the recursive formula for sub-set sum (SSS). Construct DP table and track the elements for the following input set and sum value:
Input set, $A = \{3, 2, 7, 1\}$, Sum, $S = 6$.
- Q.5(c)** Prove greedy choice property for Fractional knapsack problem. 08
- Q.6(a)** Find all possible solutions for the 4×4 chessboard and 4- queens problems. 14
- Q.6(b)** Differentiate between Dijkstra's and Bellman Ford single source shortest path algorithms. Explain their runtime complexities. 10
- Q.6(c)** Find the shortest path from node S in the graph of Fig. 6 (c) using Bellman Ford algorithm. 11



Derive the result up to $i = 3$ edges.

- Q.7(a)** Why do Stack and Queue data structures appropriate for DFS and BFS respectively? 5
- Q.7(b)** Illustrate the differences between Prim's and Kruskal's minimum spanning tree approaches with an example. 10
- Q.7(c)** Distinguish between sequential algorithm and parallel algorithm. Use appropriate example. 12
- Q.7(d)** Define the following terms: 8
- Digraph
 - Degree
 - Bipartite Graph
 - Walk in a graph
- Q.8(a)** Apply Ford-Fulkerson method to compute a maximum flow in the flow network in Figure 8(a). 15



- Q.8(b)** Write down parallel version of Merge sort algorithm. 07
- Q.8(c)** Prove that P = NP. Explain and prove Cook's theorem. 08
- Q.8(d)** Explain graph representation techniques with associated advantages and disadvantages. 05

-The End-

**Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2021**

**Course No.: Math-243
Course Title: Vector Calculus, Linear Algebra and Complex
Variables**

Time: 3 Hours**Marks: 210**

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 gradient of a scalar function. What is the directional derivative of $\varphi = xy^2 + yz^2$ at the point $(2, -1, 1)$ in the direction of normal to the surface $x\log z - y^2 = 4$ at $(-1, 2, 1)$? 17 |
| Q.1(b) | Prove that $\vec{f} = (2x + yz) \hat{i} + (4y + zx) \hat{j} - (6z - xy) \hat{k}$ is solenoidal as well as irrotational. Also find the scalar potential of \vec{f} . 18 |
| Q.2(a) | Define line integral of a vector function. Evaluate $\oint_c (3x^2 - 8y^2) dx + (4y - 6xy) dy$, where c is the boundary of the region defined by $y = x^2$ and $y = \sqrt{x}$. 15 |
| Q.2(b) | Define Surface integrals in the xy-plane, yz-plane and xz-plane. Evaluate $\iint_S \vec{F} \cdot \hat{n} ds$ where $\vec{F} = 4x \hat{i} - 2y \hat{j} + z^2 \hat{k}$ is taken in the region bounded by $x^2 + y^2 = 4$, $z = 0$, $z = 3$. 20 |
| Q.3(a) | State Stoke's theorem. Verify Stoke's theorem for $\vec{F} = -y^3 \hat{i} + x^3 \hat{j}$ where S is the circular disc $x^2 + y^2 = 1$, $z = 0$. 20 |
| Q.3(b) | The electric potential in a region of space is given by $V = 5x - 7x^2y + 8y^2 + 16yz - 5z$ volt. Where distance are measured in meters. Deduce an expression for electric field intensity \vec{E} . 15 |
| Q.4(a) | Define basis, dimension and kernel of a matrix. Express the vector $\begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix}$ as a linear combination of the vectors $\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 0 \\ 4 \end{bmatrix}$. 20 |
| Q.4(b) | Show that the vectors $(2, 1, 4), (1, -1, 2), (3, 1, -2)$ form a basis for \mathbb{R}^3 (\mathbb{R}). 15 |

Section-B

Q.5(a) Define analytic function $f(z)$ at $z = z_0$. An electrostatic field in the xy -plane is given by the potential function $\varphi = 3x^2y - y^3$. Find the stream function and complex potential. 20

Q.5(b) Evaluate $\int_C \frac{2z+3}{z} dz$ where C is upper half of the circle $|z| = 2$ in clockwise direction. 07

Q.5(c) Find $\oint_C \frac{z \cos z}{(z-\pi/2)^2} dz$, where C is $|z-i| = 1$. 08

Q.6(a) State Cauchy's Integral Formula. Evaluate the following integral by the Cauchy's Integral Formula: 15

$$(i) \int_C \frac{e^{2z}}{(z+1)^3} dz \text{ where } C : |z| = 3$$

$$(ii) \int_C \tan z dz \text{ where } C \text{ is } |z| = 2$$

Q.6(b) Define Bilinear transformation. Find the bilinear transformation which maps the points ∞ , i and 0 of z -plane to the points 0 , i and ∞ respectively of w -plane. 12

Q.6(c) Show that the transformation $w = \frac{z-1}{z+1}$ maps the inside of the unit circle in the z -plane to the left half of the w -plane. 08

Q.7(a) What is the difference between pole and removable isolated singularity. 20

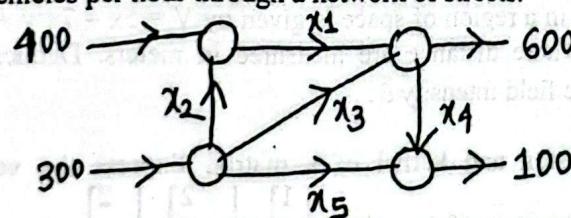
Determine the poles of the function $f(z) = \frac{(z-1)}{(z+1)^2(z+2)}$ and the residue at each pole. Hence evaluate $\oint_C \frac{z-1}{(z+1)^2(z+2)} dz$ where C is $|z-i| = 2$.

Q.7(b) Evaluate any one of the following contour integral 15

$$(i) \int_0^{2\pi} \frac{d\theta}{5+3\cos\theta}$$

$$(ii) \int_0^\infty \frac{x^2 dx}{x^4+5x^2+6}$$

Q.8(a) Define the augmented matrix. The figure shows the flow of traffic in vehicles per hour through a network of streets. 20



(i) Set up a system of linear equations to represent the network shown. Then solve this system for x_i , $i = 1, 2, 3, 5$.

(ii) Find the traffic flow when $x_3 = 0$ and $x_5 = 100$.

Q.8(b) Investigate for what values of λ , μ the simultaneous equations: 15

$$x + 2y + z = 8$$

$$2x + y + 3z = 13$$

$$3x + 4y - \lambda z = \mu$$

have (i) no solution

(ii) a unique solution

and (iii) infinitely many solutions.

-The End-

**Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2021**

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) | Distinguish between Continuous-time and Discrete-time signals. Write down the characterizing properties of continuous-time and discrete-time sinusoids. Draw appropriate figures. | 11 |
| Q.1(b) | Define sampling period. With necessary figure, explain the periodic sampling of an analog signal. Show that the frequency variables F and f are linearly related. | 12 |
| Q.1(c) | A discrete-time signal $x(n) = 6.35\cos(\pi/10)n$ is quantized with a resolution (i) $\Delta = 0.1$ or (ii) $\Delta = 0.02$. How many bits are required in the A/D converter in each case? | 06 |
| Q.1(d) | Show that the SQNR increases approximately 6dB for every bit added to the word length of A/D converter. | 06 |
| Q.2(a) | Distinguish between Symmetric and antisymmetric signals. Show that, any arbitrary signal can be expressed as the sum of two signal components, one of which is even and the other is odd. | 11 |
| Q.2(b) | Sketch the block diagram representation of the discrete-time system described by the input-output relation:
$y(n) = 2x(n) + x(n-1)$
Determine if the system above are time invariant or time variant. | 12 |
| Q.2(e) | Differentiate between:
(i) Linear and nonlinear systems
(ii) Static and dynamic systems
(iii) Energy and power signals | 12 |
| Q.3(a) | The impulse response of a linear time invariant system is:
$h(n) = \{1, 2, -1, 1\} \quad \begin{pmatrix} 1 & -1 & 2 & 1 \\ \uparrow & & & \end{pmatrix}$
Determine the response for the input signal
$x(n) = \{1, 2, 3, 1\}.$ | 12 |
| Q.3(b) | Determine the crosscorrelation sequence $r_{xy}(l)$ of the sequences:
$x(n) = \{\dots, 0, 0, 2, 3, -1, 7, 1, 2, -3, 0, 0, \dots\}$
$y(n) = \{\dots, 0, 0, 1, -1, -2, 2, 3, 1, -2, 5, 0, 0, \dots\}$ | 13 |
| Q.3(c) | Determine the autocorrelation sequence of the flowing signal:
$x(n) = \{1, 2, 3, 1\}.$ | 10 |

- Q.4(a) What is region of Convergence (ROC) in Z transform? What would be the ROC for causal, anticausal and two sided signals? Describe by plotting those for infinite duration Discrete signals. 15
- Q.4(b) Find the Z transform of the signal given below: 15
 $x(n) = [5(4^n) - 4(5^n)] u(n)$
 Also, Find $Z\{x(n-2)\}$.
- Q.4(c) Define poles and zeros with an example. 05

Section-B

- Q.5(a) "It is possible that every signal could not be transmitted into z domain." 10
 Do you agree with it? State your answer with possible example.
- Q.5(b) "Pole location describes the time domain behavior of a signal", Describe with an example. 10
- Q.5(c) Define natural and forced response of a causal signal. 10
- Q.5(d) Given $x(n) = \{2, 4, 6, 8, 1, 0\}$. Evaluate $X^+(z)$. 05
- Q.6(a) What is eigenfunction and eigenvalue? Show that output $y(n)$ of a system $h(n)$ is, $y(n) = AH(w) e^{jwn}$, with complex exponential input. 12
- Q.6(b) Let the system is defined as, $y(n) = 3y(n-1) + x(n)$.
 Determine the system response to the input:
 $x(n) = 4e^{jwn}$, for $w = \pi/3, \pi/6$ and π . 15
- Q.6(c) Define different types of filter. Do you think a LTI system could work as a filter? 08
- Q.7(a) Describe the construction and operation of an oversampling D/A converter. 12
- Q.7(b) Briefly discuss on the relationship of the Fourier Transform and Z-transform. 11
- Q.7(c) Depending on the continuous and discrete nature along with periodic and aperiodic nature of a signal, Plot the Fourier transformed output for each categories. 12
- Q.8(a) A discrete time signal is given below: 20
 $x(n) = \{0, 0.5, 1, 0.5, 0, -0.5, 0, 0.5\}$
- Q.8(b) Compute DFT of the signal by using correlation.
 With necessary figure, explain how the FFT works. Explain all the steps. 15

-The End-

$$Y(w) = 3 e^{jw} Y(w) + X(w)$$

$$(1 - 3e^{-jw}) Y(w) = X(w)$$

$$\frac{1}{1 - 3e^{-jw}}$$

2

**Chittagong University of Engineering and Technology
Department of Computer Science and Engineering
B. Sc. Engineering Level-2, Term-II, Exam. 2021**

**Course No.: CSE-251
Course Title: Data Base Management Systems**

Time: 3 Hours

Marks: 210

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

- | |
|--|
| Q1(a) Describe some advantages of database management system over using file-processing system with examples. Also, identify a major disadvantage of DBMS. 10 |
| Q1(b) Explain the procedure of processing a query inside a database engine with proper illustration. 10 |
| Q1(c) How does the recovery manager ensure the 'Atomicity' and 'Durability' properties of a database? 10 |
| Q1(d) Differentiate between different levels of abstraction. 05 |
| Q2 Design an ER diagram for keeping track of the exploits of your favorite sports team. 35
You should store – <ul style="list-style-type: none"> • The matches played • The scores in each match • The players in each match Individual player statistics for each match
(Summary statistics should be modeled as derived attributes).
Then transform this ER diagram into relational mapping. |
| Q3(a) What is Key? With the help of proper examples, explain the concepts of super key, primary key, candidate key and foreign key. 15 |
| Q3(b) Consider the following Relational Databases of Bank: 20 |

```

branch (branch_name, branch_city, assets)
customer (customer_name, customer_street, customer_city)
account (account_number, branch_name, balance)
loan (loan_number, branch_name, amount)
depositor (customer_name, account_number)
borrower (customer_name, loan_number)

```

Fig. 3(b)

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Write down the following queries in Relational Algebra Expression:

- ✓ 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 'Pahartali' branch
- ✓ iii. Find the names of all customers who have a loan and an account at the bank
- ✓ iv. Find the loan number for each loan of an amount greater than \$1200.

Q.4(a) Consider the table named OFFER in Fig. 4(a):

15

OFFER

Course	Instructor	Textbook
Data Base Management Systems	A	Korth
	B	Elmasri
	C	
Operating Systems	D	Galvin Tanenbaum

Fig. 4(a)

- i. Determine the normal form of this relation.
- ii. What are the dependencies exist in this relation?
- iii. Convert the relation up to fourth normal form.

Q.4(b) Consider the table 'WORKERS' shown in Fig. 4(b):

10

WORKERS

EID	Name	DEPT	Address	Hours/Week
1	Berlin	D1	Pahartali	10
1	Berlin	D2	Pahartali	10
2	Tokyo	D3	Agrabad	15
3	Mashrafe	D1	Hathazari	07
3	Mashrafe	D3	Hathazari	08

Fig. 4(b)

The given table shows time spent by part time workers. Identify the anomalies and normalize up to 3NF.

Q.4(c) What is the purpose of normalization? Explain different types of anomalies in respect of sample data of Fig. 4(c).

10

SALES

CID	Name	Salesperson	Region
1	A	Smith	South
2	B	Hicks	West
3	C	Smith	South
4	D	Hernandez	East
5	E	Hicks	West
6	F	Murad	North
7	G	Alam	South

Fig. 4(e)**Section-B**

- ✓ Q.5(a) Explain the concepts of primary index, dense index, secondary index and sparse index. 12
- Q.5(b) Construct a B+ tree for the following set of key values where the number of pointers in a node is four: (Assume that the tree is initially empty and values are added in ascending order) 23

1, 4, 5, 9, 11, 13, 17, 19, 29, 37, 43, 45, 60, 70

Also show the form of the tree after each of the following series of operations:

- i. Insert 18
- ii. Insert 26
- iii. Delete 5
- iv. Delete 9

- ✓ Q.6(a) Describe different states of database transaction with example. Based on what conditions, two schedules can be declared as view equivalent? 10
- Q.6(b) Describe Authorization, Assertion and Materialized view with proper example. 10
- Q.6(c) Consider the three relations are given as- 15

customer (<u>nid</u> , name, occupation, city)
account (<u>acc_number</u> , type, opening_balance, opening_date, branch_id, <u>nid</u>)
transaction (<u>tnx_number</u> , date, amount, <u>acc_number</u>)

Write down the SQL statements for the following queries:

- i. Create the above mentioned relations by assigning necessary data types, constraints
- ii. Show the total number of accounts opened in the month of February

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R1W

- iii. Find the account numbers in which more than one transaction was done of BDT 500 or more
- iv. Show the total amount of transactions in a single day
- v. Find the account numbers of customer living in 'Chattogram'.

- Q.7(a) Describe system deadlock with example. How can deadlock be prevented? 08
 Q.7(b) Describe Timestamp Ordering Protocol. Also, explain the procedures followed by a database system when a transaction, T_i , issues 'write' operation. 12
 Q.7(c) Consider the following relations to write SQL statements for given queries: 15

OTT_Platform (<u>pid</u> , name, start_date, revenue)
Customer (<u>cid</u> , user_name, device_count)
Subscription (<u>sid</u> , price, type, pid)
Buys (<u>cid</u> , <u>sid</u> , <u>pid</u> , purchase_date, duration)

- i. List the OTT platforms according to their revenue from highest to lowest
- ii. Find the total number of subscriptions that has been bought for each platform
- iii. Find the customer's name and their subscription type, for those customers whose subscription is active (meaning expiry date is not finished).

- ✓ Q.8(a) Differentiate between: 15
- i. Speed up and Scale up
 - ii. Shared-Memory and Shared-Nothing
 - iii. Homogeneous and Heterogeneous Distributed Database
- Q.8(b) Briefly explain the operational principle of two-phase commit protocol. 10
 Q.8(c) Consider the 'Course' relation and 'Prereq' relations as shown below: 10

Course

Course_Id	Title	Dept_Name	Credits
CSE-251 ✓	DBMS	CSE	3
CSE-335 ✓	OS	CSE	3
CSE-241 ✓	DS	CSE	3
CSE-111	DM	CSE	3

Prereq

Course_Id	Preq_Id
CSE-251	CSE-241
CSE-335	CSE-241
CSE-241	CSE-111

Based on the above two relations, find the results of the following join operations:

- i. Course natural right outer join Prereq
- ii. Course full outer join Prereq using (Course_ID)

-The End-

(to be continued)
S. S. S.