SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2022-2023 **Semester: 3rd** **Date: 16-11-2022**

Course Title: DISCRETE MATHEMATICAL STRUCTURES

Course Code: MAT2004

Type of Session: Problem Solving Methodology.

Instructor in Charge: Dr. Bhavya K and Dr. Rajeshwari M

Instructor for Section: Dr Rajeshwari M, Dr. Bhavya K, Dr. Naveen Kumar, Dr. Sandeep Kumar, Dr.Amita Soni

Advanced Learner Instructor for the session: Dr Rajeshwari M, Dr. Bhavya K, Dr. Naveen Kumar, Dr. Sandeep Kumar, Dr.Amita Soni

Name of the Module: Module 1 and 2

Topics in the Module: logics, NAND and NOR, Propositions

Mode of Instruction: Offline

Teaching Pedagogy: **Self-assessment – Assignment**

Assignment Questions:

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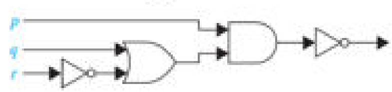
Presidency University, Bengaluru
School of Engineering

Department of Mathematics

2022-23 3rd Semester

Course: Discrete Mathematical Structures
Course Code: MAT2004
FAST LEARNER ASSIGNMENT

1. In Smullyan posed many puzzles about an island that has two kinds of inhabitants, knights, who always tell the truth, and their opposites, knaves, who always lie. You encounter two people A and B. What are A and B if A says "B is a knight" and B says "The two of us are opposite types?"
2. Build a digital circuit that produces the output $(p \vee \neg r) \wedge (\neg p \vee (q \vee \neg r))$ when given input bits p, q, and r.
3. Find the output of each of these combinatorial circuits.



4. Show that ¬, ∧, and ∨ form a functionally complete collection of logical operators.
5. We have seen that the bit string for the set {1, 3, 5, 7, 9} (with universal set {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}) is 10 1010 1010. What is the bit string for the complement of this set?

Assignment Sample Copy:

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From:-

Name: Ruftha.P.S

Roll no: 2021CDV0052

Section: 3-CDV-01

Program: B.tech(Devops)

Course: Discrete mathematics

Coursecode: MAT2004

Date of submission: 02/10/22

To:

Bhavya mam

presidency university

Banglore-64

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Fast learner Assignment

Q1) In Smullyan posed many puzzles about an island that has two kinds of inhabitants, knights, who always tell the truth, and their opposites, knaves who always lie. You encounter two people A and B. What are A and B if A says "B is a knight" and B says "The two of us are opposite types?"

Ans: let,

p = A is a knight

q: B is a knight

so that, ¬p and ¬q are the statements that

¬p = A is a knave

¬q = B is a knave

we first consider the possibility that A is a knight where p is true.

If A is a knight, then he's telling the truth when he says that B is a knight. So that q is true and A and B are the same type.

However, if B is a knight, then B's statement that A and B are of opposite types, then

(p∧¬q) ∨ (¬p∧q), would be true, which is not, because A and B are both knights. consequently, we can conclude that A is not a knight, that is, that p is false.

If A is a knave, then because everything a knave says is false. A's statement that B is a knight, that is, that q is true, is a lie. This means that q is false and B is also a knave.

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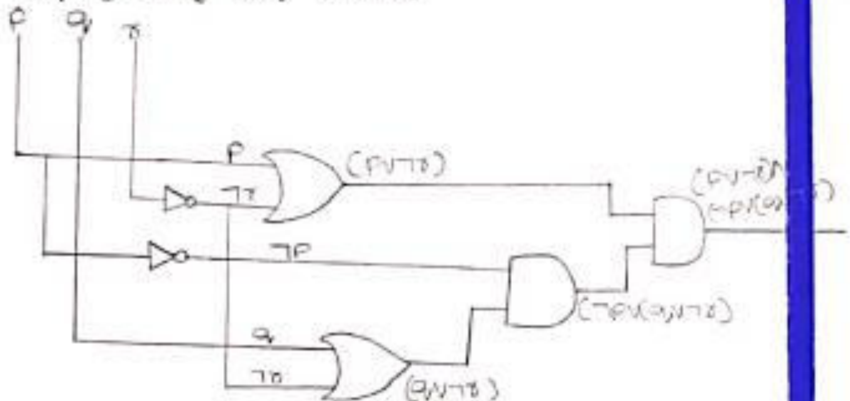
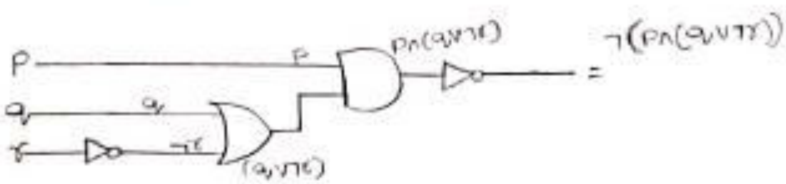
Furthermore, if B is a knave, then B's statement that A and B are opposite types is a lie, which is consistent with both A and B being knaves. We can conclude that both A and B are knaves.

Q2. Build a digital circuit that produces the output $(p \vee \neg r) \wedge (\neg p \vee (q \vee \neg r))$ when given input bits p, q and r.



Q3. Find the output of each of these combinational circuits.



$= \neg(p \wedge (q \vee \neg r))$

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Q4] Show that ¬, ∧, and ∨ form a functionally complete collection of logical operators.

Soln: If it is then possible to rewrite a conjunction using only negations and disjunctions, then ¬ and ∨ form a functionally complete collection of logical operators.

By De morgan's law, we know

$\neg(p \wedge q) \equiv \neg p \vee \neg q$

Let us take the negation of each compound proposition

$\neg(\neg p(\wedge q)) \equiv \neg(\neg p \vee \neg q)$

Using the double negation law, we then obtain:

$p \wedge q \equiv \neg(\neg p \vee \neg q)$

Thus a conjunction can be rewritten using only negations and disjunction, thus ¬ and ∨ form a functionally complete collection of logical operators.

Q5] We have seen that the bit string for the set {1, 3, 5, 7, 9} (with universal set {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}) is 10 1010 1010. What is the bit string for the complement of this set?

Soln:- The bit string for the complement of this set is obtained by replacing 0s with 1s and vice versa. This yields the string

01 0101 0101,

> which corresponds to the set {2, 4, 6, 8, 10}

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5	20211CAI0146	DEEPESH KULAL NAVOOR
6	20211CAI0112	SHOVIN WILSON A W
7	20211CAI0115	AISHWARYA VILAS PATIL
8	20211CAI0118	VAIBHAV GUPTA
9	20211CAI0125	MOHAMMED IQLAAS
10	20211CAI0141	MANISH PRAVEEN BHAT
11	20211CAI0159	SAFIA RAFI
12	20211CAI0160	SANGATI SIVA ANJANEYULU
13	20211CAI0167	VUTHARAJI YASWANTH
14	20211CAI0180	GADDAM SAI LIKHITHA
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17	20211CBC0041	GAGAN P
18	20211CBC0044	K V ACHYUTH REDDY
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23	20211CBD0021	VIJAYEENDRA N
24	20211CBD0031	MEGHANA BADIGER
25	20211CBD0032	LOKESH J
26	20211CBD0037	SYEADA SUFIYA MOOSA
27	20211CBD0039	CHAITHANYA M
28	20211CBD0042	GAGAN RAAM S
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30	20211CCS0004	KODURI SAI CHAITANYA
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94	20211CSE0057	MUKTHALA KIRAN KUMAR
95	20211CSE0408	V HARSHINI
96	20211CSE0421	SINCHANA A U
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101	20211CSE0480	KOTHA GREESHMA REDDY
102	20211CSE0492	KONDURU HARSHITHA
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128	20211CSE0736	THUMMALAPALLE VAMSHIKA
129	20211CSE0749	KONDURU PRIYANKA
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131	20211CSE0759	VELICHALAMALA SUMA VARSHA
132	20211CSE0789	KASUMURTHY HARSHITHA
133	20211CSE0824	PATHAKAMURI HARISHTHA
134	20211CSE0830	AADITYA KUMAR
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136	20211CSE0835	AAKIF MOHAMED NADEEM
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140	20211CSE0104	YALAMANDALA GOWTHAM NAIDU
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144	20211CSE0120	TADIPATHRI LIKHITH GANESH
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176	20211CSE0241	G K RAGHAVENDRA RAO
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180	20211CSE0276	SANGATI CHARITHA
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185	20211CSE0324	HEMA DEEPIKA MIKKILI

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190	20211CSE0352	DARSHAN A R
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196	20211CSE0377	DINSON SAM THOMAS
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208	20211CSE0397	SWATHI P S
209	20211CSE0398	THAQIYA AMAN S
210	20211CSE0401	DILIP D
211	20211CSG0074	CHANDRASHEKHAR K S
212	20211CSG0005	SHREYAS D M
213	20211CSG0007	ANVITA V SAJEEVAN
214	20211CSG0015	YASHASWI A
215	20211CSG0067	MONICA V
216	20211CSG0070	MRINAL A
217	20211CSG0002	BHUVANESHWAR C
218	20211CSG0008	PRANAV S
219	20211CSG0018	M KRITHI
220	20211CSG0020	ANIRUDHA R NAYAK
221	20211CSG0021	PAWAN P
222	20211CSG0027	RAKSHITHA S
223	20211CSG0052	MANASA C S

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225	20211CST0012	YENDLURI AMARNATH CHOWDARY
226	20211CST0082	GRESHMA DC
227	20211CST0039	BOBBITI YASWANTH REDDY
228	20211CST0092	MEKALA CHARAN KUMAR

Total Number of Eligible Students : 228

Total Number of Students Submitted : 220

Signature of Instructor:

Signature of Instructor In-Charge :

HOD - MATHS

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

Private University Estd. in Karnataka State by Act No. 41 of 2013

SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2022-2023 **Semester: 1st** **Date: 02-02-2023**

Course Title: Matrix Computations for Data Science

Course Code: MAT2023

Type of Session: Problem Solving

Instructor in Charge: Dr. Ashish Kumar Prasad

Instructor for Section: Dr. Ashish Kumar Prasad

Advanced Learner Instructor for the session: Dr. Ashish Kumar Prasad

Name of the Module: Linear Systems

Topics in the Module: Gauss Elimination

Mode of Instruction: Offline

Teaching Pedagogy: Self-assessment – Assignment

Assignment Questions:

Solve the following system using Gauss-Jordan Method:

1.

$$\begin{aligned} x_1 + 2x_2 - 3x_3 &= 9 \\ 2x_1 - x_2 + x_3 &= 0 \\ 4x_1 - x_2 + x_3 &= 4 \end{aligned}$$

$$\begin{aligned} x - y + z &= 0 \\ -x + 3y + z &= 5 \\ 3x + y + 7z &= 2 \end{aligned}$$

2.

$$\begin{aligned} x_1 - 3x_2 - 2x_3 &= 0 \\ -x_1 + 2x_2 + x_3 &= 0 \\ 2x_1 + 4x_2 + 6x_3 &= 0 \end{aligned}$$

3.

$$\begin{aligned} 2w + 3x - y + 4z &= 1 \\ 3w - x + z &= 1 \\ 3w - 4x + y - z &= 2 \end{aligned}$$

4.

$$\begin{aligned} 2r + s &= 3 \\ 4r + s &= 7 \\ 2r + 5s &= -1 \end{aligned}$$

5.

$$\begin{aligned} \sqrt{2}x + y + 2z &= 1 \\ \sqrt{2}y - 3z &= -\sqrt{2} \\ -y + \sqrt{2}z &= 1 \end{aligned}$$

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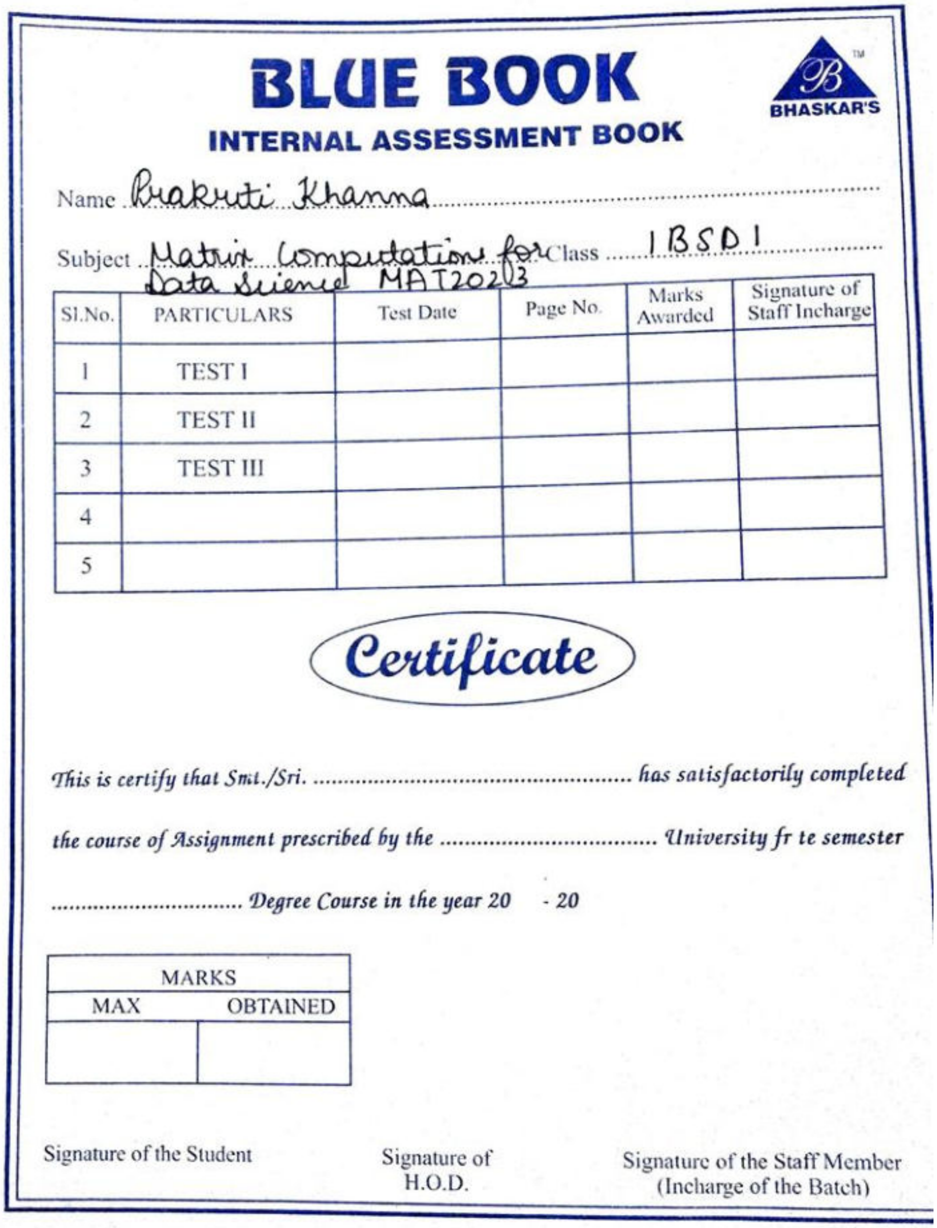
Assignment Sample Copy:



BLUE BOOK

BHASKAR'S

INTERNAL ASSESSMENT BOOK

Name: Prakruti Khanna

Subject: Matrix Computations for Data Science MAT2023 Class: 1BSD1

Sl.No.	PARTICULARS	Test Date	Page No.	Marks Awarded	Signature of Staff Incharge
1	TEST I				
2	TEST II				
3	TEST III				
4					
5					

Certificate

This is certify that Smt./Sri. .... has satisfactorily completed the course of Assignment prescribed by the .... University fr te semester .... Degree Course in the year 20 - 20

MARKS	
MAX	OBTAINED

Signature of the Student

Signature of H.O.D.

Signature of the Staff Member (Incharge of the Batch)

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Date 29/12/22
Page

Assignment

① $x_1 + 2x_2 - 3x_3 = 9$
$2x_1 - x_2 + x_3 = 0$
$4x_1 - x_2 + x_3 = 4$

$$\left[\begin{array}{ccc|c} 1 & 2 & -3 & 9 \\ 2 & -1 & 1 & 0 \\ 4 & -1 & 1 & 4 \end{array}\right] \quad \times -2 \quad \times -4$$

$$\left[\begin{array}{ccc|c} 1 & 2 & -3 & 9 \\ 0 & -5 & 7 & -18 \\ 0 & -9 & 13 & -32 \end{array}\right] \quad \times -\frac{1}{5}$$

$$\left[\begin{array}{ccc|c} 1 & 2 & -3 & 9 \\ 0 & 1 & -7/5 & 18/5 \\ 0 & -9 & 13 & -32 \end{array}\right] \quad \times -2 \quad \times 9$$

$$\left[\begin{array}{ccc|c} 1 & 0 & -1/5 & 9/5 \\ 0 & 1 & -7/5 & 18/5 \\ 0 & 0 & 2/5 & 2/5 \end{array}\right] \quad \times \frac{5}{2}$$

$$\left[\begin{array}{ccc|c} 1 & 0 & -1/5 & 9/5 \\ 0 & 1 & -7/5 & 18/5 \\ 0 & 0 & 1 & 1 \end{array}\right] \quad \times \frac{7}{5} \quad \times \frac{1}{5}$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 5 \\ 0 & 0 & 1 & 1 \end{array}\right]$$

$\therefore x_1 = 2;\ x_2 = 5;\ x_3 = 1$

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② $\sqrt{2}x + y + 2z = 1$
$\sqrt{2}y - 3z = -\sqrt{2}$
$-y + \sqrt{2}z = 1$

$$\left[\begin{array}{ccc|c} \sqrt{2} & 1 & 2 & 1 \\ 0 & \sqrt{2} & -3 & -\sqrt{2} \\ 0 & -1 & \sqrt{2} & 1 \end{array}\right] \times \frac{1}{\sqrt{2}}$$

$$\left[\begin{array}{ccc|c} \sqrt{2} & 1 & 2 & 1 \\ 0 & 1 & -3/\sqrt{2} & -1 \\ 0 & -1 & \sqrt{2} & 1 \end{array}\right] \begin{array}{l} \times \frac{1}{\sqrt{2}} \\ \times 1 \end{array}$$

$$\left[\begin{array}{ccc|c} 1 & 1/\sqrt{2} & \sqrt{2} & 1/\sqrt{2} \\ 0 & 1 & -3/\sqrt{2} & -1 \\ 0 & 0 & -1/\sqrt{2} & 0 \end{array}\right] \times -\sqrt{2}.$$

$$\left[\begin{array}{ccc|c} 1 & 1/\sqrt{2} & \sqrt{2} & 1/\sqrt{2} \\ 0 & 1 & -3/\sqrt{2} & -1 \\ 0 & 0 & 1 & 0 \end{array}\right]$$

$$\left[\begin{array}{ccc|c} 1 & 1/\sqrt{2} & 0 & 1/\sqrt{2} \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 0 \end{array}\right] \times \frac{-1}{\sqrt{2}}$$

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & \sqrt{2} \\ 0 & 1 & 0 & -1 \\ 0 & 0 & 1 & 0 \end{array}\right]$$

$\therefore x_1 = \sqrt{2};\ x_2 = -1;\ x_3 = 0$

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Date ____
Page ____

③ $\frac{2}{x} + \frac{3}{y} = 0$

$\frac{3}{x} + \frac{4}{y} = 1$

Let $\frac{1}{x} = p$; $\frac{1}{y} = q$

$\Rightarrow 2p + 3q = 0$

$3p + 4q = 1$

$$\left[\begin{array}{cc|c} 2 & 3 & 0 \\ 3 & 4 & 1 \end{array}\right] \times \frac{1}{2}$$

$$\left[\begin{array}{cc|c} 1 & 3/2 & 0 \\ 3 & 4 & 1 \end{array}\right] \times -3$$

$$\left[\begin{array}{cc|c} 1 & 3/2 & 0 \\ 0 & -1/2 & 1 \end{array}\right] \times -2$$

$$\left[\begin{array}{cc|c} 1 & 3/2 & 0 \\ 0 & 1 & -2 \end{array}\right] \times -\frac{3}{2}$$

$$\left[\begin{array}{cc|c} 1 & 0 & 3 \\ 0 & 1 & -2 \end{array}\right]$$

$p = 3$; $q = -2$

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$p = \frac{1}{x} \Rightarrow x = \frac{1}{3}$

$q = \frac{1}{y} \Rightarrow y = \frac{-1}{2}$

(4) $x_2 + 2x_3 = 5$
$x_1 + 2x_2 + 5x_3 = 13$
$x_1 + 2x_3 = 4$

$$\left[\begin{array}{ccc|c} 0 & 1 & 2 & 5 \\ 1 & 2 & 5 & 13 \\ 1 & 0 & 2 & 4 \end{array}\right]$$

$$\left[\begin{array}{ccc|c} 1 & 2 & 5 & 13 \\ 0 & 1 & 2 & 5 \\ 1 & 0 & 2 & 4 \end{array}\right] \times -1$$

$$\left[\begin{array}{ccc|c} 1 & 2 & 5 & 13 \\ 0 & 1 & 2 & 5 \\ 0 & -2 & -3 & -9 \end{array}\right] \times 2$$

$$\left[\begin{array}{ccc|c} 1 & 2 & 5 & 13 \\ 0 & 1 & 2 & 5 \\ 0 & 0 & 1 & 1 \end{array}\right]$$

$x_3 = 1$

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Date ____
Page ____

$x_2 + 2x_3 = 5$

$x_2 + 2(1) = 5 \Rightarrow x_2 = 3$

$x_1 + 2x_2 + 5x_3 = 13$
$x_1 + 6 + 5 = 13$
$x_1 = 2$

$\therefore x_1 = 2; \; x_2 = 3; \; x_3 = 1$

(5) $-2^a + 2(3^b) = 1$
$3(2^a) - 4(3^b) = 1$

Let $2^a = p$, $3^b = q$

$\Rightarrow -p + 2q = 1$
$3p - 4q = 1$

$\left[\begin{array}{cc|c} -1 & 2 & 1 \\ 3 & -4 & 1 \end{array}\right] \times -1$

$\left[\begin{array}{cc|c} 1 & -2 & -1 \\ 3 & -4 & 1 \end{array}\right] \times -3$

$\left[\begin{array}{cc|c} 1 & -2 & -1 \\ 0 & 2 & 4 \end{array}\right] \times \frac{1}{2}$

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$$\left[\begin{array}{cc|c} 1 & -2 & -1 \\ 0 & 1 & 2 \end{array}\right] \uparrow \times 2$$

$$\left[\begin{array}{cc|c} 1 & 0 & 3 \\ 0 & 1 & 2 \end{array}\right]$$

$p = 3$; $q = 2$

$p = 2^a$	$q = 3^b$
$3 = 2^a$	$2 = 3^b$
$a = \log_2(3)$	$b = \log_3(2)$

Submission Records:

Sl. No	Roll Number	Name of the Student
1	20221BSD001	A POORANI MARAGATHAVALLI
2	20221BSD002	SHLOAK SATISH SHETTY
3	20221BSD003	PRAKRITI KHANNA
4	20221BSD004	ADRIAN CHARLES
5	20221BSD006	BAJOLGEKAR YOGESH
6	20221BSD007	SHRISHTI
7	20221BSD008	KOTA YOGANANDA REDDY
8	20221BSD009	PAVINESH R
9	20221BSD0010	SURYA A J
10	20221BSD0011	AHAMED FARAZ

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		MOHAMMAD SADIQ
11	20221BSD0012	JEEVAN KUMAR K
12	20221BSD0013	RISHABH TIKNOO
13	20221BSD0014	PURUSHOTHAM V
14	20221BSD0015	GUTURU NAGAKARTHIKEYA
15	20211BSD0017	ALI HUSAYIR
16	20211BSD0019	TEJAS M P

Total Number of Eligible Students : 16

Total Number of Students Submitted : 16

Signature of Instructor:

Signature of Instructor In-Charge :

HOD - MATHS

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SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2022-2023 **Semester: 1ST** **Section: 1BSC** **Date: 4-9-2022**

Course Title: BASIC MATHEMATICS FOR ECONOMICS

Course Code: MAT1011

Type of Session: Peer learning

Instructor in Charge: Dr. SHILPA. N.

Instructor for Section: Dr. SHILPA. N.

Advanced Learner Instructor for the session: Dr. SHILPA. N.

Name of the Module: Introduction to Calculus

Topics in the Module: The differential calculus, Rules for differentiation, Marginal revenue and total revenue, Marginal cost and total cost, Profit maximization, Respecifying functions, Point elasticity of demand, The Keynesian multiplier.

Mode of Instruction: Offline

Teaching Pedagogy: **Self-assessment – Assignment**

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Assignment Questions:

Presidency University, Bangalore

School of Engineering

Course: Applied Mathematics (MAT2007)

ASSIGNMENT

1) For the given matrix $\begin{bmatrix} 3 & -2 & -1 \\ -4 & 1 & -1 \\ 2 & 0 & 1 \end{bmatrix}$, check the singularity.

2) Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & -2 & 1 \\ 0 & 1 & 0 \\ 3 & 5 & -3 \end{bmatrix}$. Find AB, if its possible and write its order.

3) Find the rank of the matrix by using Row reduced echelon form for the following matrix $\begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$.

4) Let $A = \begin{bmatrix} 1 & 2 \\ -2 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 3 \\ 4 & 3 \end{bmatrix}$. Show that $det(AB) = det(A)det(B)$, where det stands for determinant of the matrix.

5) Solve the system of equations by using Gauss Elimination method

$$2x_1 + x_2 + 4x_3 = 12$$
$$4x_1 + 11x_2 - x_3 = 33$$
$$8x_1 - 3x_2 + 2x_3 = 20.$$

6) Let $\cos\beta = \frac{\sqrt{7}}{4}$, find (a) $\sin(90^0 - \beta)$ (b) $\cot\beta$.

7) Find the values of the following

(a) $\sin 15^0$ (b) $\sin 105^0$.

8) If $\sin\theta = -\frac{24}{25}$ and θ lies in the fourth quadrant, then find the value of $\cos\theta$ and $\tan\theta$.

9) If $\sin(A - B) = \frac{1}{2}, \cos(A + B) = \frac{1}{2}$, $0 < A + B < 90^0, A > B$. Find A and B.

10) Evaluate $\frac{5\cos^2 60^0 + 4\sec^2 30^0 - \tan^2 45^0}{\sin^2 30^0 + \cos^2 30^0}$.

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Assignment Sample Copy:

FAST LEARNERS

BLUE BOOK

Achiever

INTERNAL ASSESSMENT BOOK

Name......A. POORANI MARAGATHAVALLI..........

Subject....APPLIED MATHEMATICS [MAT2007]...Class.......1BSD-01..........

Sl.No.	PARTICULARS	Test Date	Page No	Marks Awarded	Signature of Staff Incharge
1	TEST - I				
2	TEST - II				
3	TEST - III				
4					
5					

Certificate

This is to certify that Smt. / Sri...has satisfactorily completed the course of Assignment prescribed by the...............................University for the semester ....Degree Course in the Year 20 - 20

MARKS	
MAX	OBTAINED

Signature of the Student

Signature of H.O.D.

Signature of the Staff Member (Incharge of the Batch)

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ASSIGNMENT - II

Q1. Let $A = \begin{bmatrix} 3 & -2 & -1 \\ -4 & 1 & -1 \\ 2 & 0 & 1 \end{bmatrix}$. Find the determinant of the matrix and check its singularity.

$\Rightarrow$ $|A| = 3(1) + 2(-4+2) - 1(-2)$

$= 3 - 4 + 2$

$= 1$

$\therefore$ As $|A| \neq 0$, the matrix A is a non-singular matrix

Q2. Let $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & -2 & 1 \\ 0 & 1 & 0 \\ 3 & 5 & -3 \end{bmatrix}$. Find AB and write it's order.

$\Rightarrow$ $AB = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{bmatrix} \begin{bmatrix} 2 & -2 & 1 \\ 0 & 1 & 0 \\ 3 & 5 & -3 \end{bmatrix}$

$= \begin{bmatrix} 2+0+9 & -2+2+15 & 1+0-9 \\ 6+0+3 & -6+2+5 & 3+0-3 \end{bmatrix}$

$= \begin{bmatrix} 11 & 15 & -8 \\ 9 & 1 & 0 \end{bmatrix}_{2\times 3}$

$\therefore$ The order of matrix AB

$= 2\times 3$

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Q3. Find the rank of the matrix by reducing it to echelon form. $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$.

$\Rightarrow$ $R_2 \rightarrow -R_1 + R_2$, $R_3 \rightarrow -2R_1 + R_2$ $\sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & 2 & -1 \\ 0 & 2 & -1 \end{bmatrix}$

$R_2 \rightarrow 1/2 R_2$ $\sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -1/2 \\ 0 & 2 & -1 \end{bmatrix}$

$R_3 \rightarrow -2R_2 + R_3$ $\sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & -1/2 \\ 0 & 0 & 0 \end{bmatrix}$

$\therefore$ The rank of matrix, A, $\rho(A) = 2$ //

Q4. Let $A = \begin{bmatrix} 1 & 2 \\ -2 & -1 \end{bmatrix}$ & $B = \begin{bmatrix} 0 & 3 \\ 4 & 3 \end{bmatrix}$. Show that $\det(AB) = \det(A) \cdot \det(B)$, where det is determinant.

$\Rightarrow$ $AB = \begin{bmatrix} 1 & 2 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} 0 & 3 \\ 4 & 3 \end{bmatrix} = \begin{bmatrix} 0+8 & 3+6 \\ 0-4 & -6-3 \end{bmatrix}$

$= \begin{bmatrix} 8 & 9 \\ -4 & -9 \end{bmatrix}$

$\therefore \det(AB) = |AB| = -72 + 36 = -36$ /

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$|A| = -1 + 54$
$= 3$

$|B| = 0 - 12$
$= -12$

$\therefore \det(A) \cdot \det(B) = |A| \cdot |B|$
$= 3 \times -12$
$= -36$

$\therefore \det(AB) = \det(A) \cdot \det(B)$

$\therefore$ LHS = RHS

Hence Proved.

Q6. Solve the system of equation by Gauss Elimination method

$2x_1 + x_2 + 4x_3 = 12$
$4x_1 + 11x_2 - x_3 = 33$
$8x_1 - 3x_2 + 2x_3 = 20$

$$\Rightarrow A = \left[\begin{array}{ccc:c} 2 & 1 & 4 & 12 \\ 4 & 11 & -1 & 33 \\ 8 & -3 & 2 & 20 \end{array}\right]$$

$$R_1 \to 1/2 R_1 \sim \left[\begin{array}{ccc:c} 1 & 1/2 & 2 & 6 \\ 4 & 11 & -1 & 33 \\ 8 & -3 & 2 & 20 \end{array}\right]$$

$$R_2 \to -4R_1 + R_2, \quad R_3 \to -8R_1 + R_3 \sim \left[\begin{array}{ccc:c} 1 & 1/2 & 2 & 6 \\ 0 & 9 & -9 & 9 \\ 0 & -7 & -14 & -28 \end{array}\right]$$

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$R_2 \rightarrow 1/9 R_2 \sim \left[\begin{array}{ccc:c} 1 & 1/2 & 2 & 6 \\ 0 & 1 & -1 & 1 \\ 0 & -7 & -14 & -28 \end{array}\right]$

$R_3 \rightarrow 7R_2 + R_3 \sim \left[\begin{array}{ccc:c} 1 & 1/2 & 2 & 6 \\ 0 & 1 & -1 & 1 \\ 0 & 0 & -21 & -21 \end{array}\right]$

$R_3 \rightarrow -1/21 R_3 \sim \left[\begin{array}{ccc:c} 1 & 1/2 & 2 & 6 \\ 0 & 1 & -1 & 1 \\ 0 & 0 & 1 & 1 \end{array}\right]$

∴ The equations are,

$x_1 + \frac{1}{2}x_2 + 2x_3 = 6$

$x_2 - x_3 = 1$

$\boxed{x_3 = 1}$

$\therefore x_2 - x_3 = x_2 - 1 = 1$

$\therefore \boxed{x_2 = 2}$

$\therefore x_1 + \frac{1}{2} \times 2 + 2(1) = 6$

$x_1 + 1 + 2 = 6$

$x_1 + 3 = 6$

$\therefore \boxed{x_1 = 3}$

$\therefore x_1 = 3 ; x_2 = 2 ; x_3 = 1$

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Q6. Let $\cos\beta = \frac{\sqrt{7}}{4}$, find (a) $\sin(90^\circ - \beta)$
(b) $\cot\beta$

⇒ (a) $\sin(90^\circ - \beta)$

$= \cos\beta$

$= \frac{\sqrt{7}}{4}$ //

(b) $\cot\beta$

$\cos\beta = \frac{\text{Base}}{\text{Hypotenuse}} = \frac{\sqrt{7}}{4}$.

$\sin\beta = \frac{\text{Perpendicular}}{\text{Hypotenuse}}$

Using pythogoras theorem,

$x^2 + (\sqrt{7})^2 = 4^2$

$x^2 + 7 = 16$

$x^2 = 16 - 7$

$x = \sqrt{9} = 3$

$\therefore \sin\beta = \frac{3}{4}$

$\therefore \cot\beta = \frac{\cos\beta}{\sin\beta}$

$= \frac{\sqrt{7}}{4} \times \frac{4}{3}$

$\therefore \cot\beta = \frac{\sqrt{7}}{3}$ //

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Q7. Find the values of the following
(a) $\sin 15^\circ$ (b) $\sin 105^\circ$

⟹ (a) $\sin 15^\circ$

$= \sin(45^\circ - 30^\circ)$

$= \sin 45^\circ \cos 30^\circ - \cos 45^\circ \sin 30^\circ$

[∵ $\sin(A-B) = \sin A \cos B - \cos A \sin B$]

$= \frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}} \times \frac{1}{2}$

$= \frac{\sqrt{3}-1}{2\sqrt{3}}$ //

(b) $\sin 105^\circ$

$= \sin(60^\circ + 45^\circ)$

$= \sin 60 \cos 45 + \cos 60 \sin 45$

[∵ $\sin(A+B) = \sin A \cos B + \cos A \sin B$]

$= \frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{2}} + \frac{1}{2} \times \frac{1}{\sqrt{2}}$

$= \frac{\sqrt{3}+1}{2\sqrt{2}}$ //

Q8 If $\sin\theta = \frac{-24}{25}$ and θ lies in the IV Quadrant, then find the value of $\cos\theta$ & $\tan\theta$.

⟹ $\cos\theta = \sqrt{1 - \left(\frac{-24}{25}\right)} = \sqrt{1 - \frac{576}{625}} = \sqrt{\frac{625-576}{625}}$

$\therefore \boxed{\cos\theta = \frac{7}{25}}$ [∵ $\cos\theta$ is +ve in IV Quadrant]

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$\therefore \tan\theta = \dfrac{\sin\theta}{\cos\theta}$

$= \dfrac{-24}{25} \times \dfrac{25}{7}$

$\therefore \boxed{\tan\theta = \dfrac{-24}{7}}$

Q9. If $\sin(A-B) = \frac{1}{2}$, $\cos(A+B) = \frac{1}{2}$; $0 < A+B < 90°$; $A > B$. Find A & B.

$\Rightarrow$ $\sin(A-B) = \frac{1}{2} = \sin(30)$

$\therefore \sin(A-B) = \sin(30°)$

$\therefore A-B = 30 \longrightarrow (1)$

$\cos(A+B) = \frac{1}{2} = \cos(60)$

$\therefore \cos(A+B) = \cos(60)$

$\therefore A+B = 60 \longrightarrow (2)$

Adding (1) & (2),

$$\begin{aligned} A + B &= 60 \\ A - B &= 30 \\ \hline 2A &= 90 \end{aligned}$$

$\therefore \boxed{A = 45}$

$\therefore A+B = 60$; $45 + B = 60$

$\therefore \boxed{B = 15}$

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Q10. Evaluate $\dfrac{5\cos^2 60^\circ + 4\sec^2 30^\circ - \tan^2 45^\circ}{\sin^2 30^\circ + \cos^2 30^\circ}$

$$\rightarrow = \frac{5 \times \left(\frac{1}{2}\right)^2 + 4 \times \left(\frac{2}{\sqrt{3}}\right)^2 - (1)^2}{\left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2}$$

$$= \frac{5 \times \frac{1}{4} + 4 \times \frac{4}{3} - 1}{1}$$

$$= \frac{5}{4} + \frac{16}{3} - 1$$

$$= \frac{15 + 64 - 12}{12}$$

$$= \frac{67}{12}$$ //

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Submission Records:

Sl. No	Roll Number	Name of the Student	P/AB
1	20221BSE0001	R K S H KASHYAP	P
2	20221BSE0002	PARAJ YAMAN	P
3	20221BSE0003	RENAISSA DAS	P
4	20221BSE0004	PASHIKANTI SRIMAYEE	P
5	20221BSE0005	SAMBANA HEMAVATI	P
6	20221BSE0007	KATIKITALA VINCENT	P

Total Number of Eligible Students : 06

Total Number of Students Present : 06

Total Number of students Absent : 00

Signature of Instructor:

Signature of Instructor In-Charge :

HOD - MATHS

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SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2022-2023 **Semester: 2nd** **Date: 22-05-2023**

Course Title: STATISTICAL METHODS AND TECHNIQUES

Course Code: MAT1006

Type of Session: Participative learning

Instructor in Charge: Dr. M.Rajeshwari

Instructor for Section: Dr. M.Rajeshwari

Advanced Learner Instructor for the session: Dr. M.Rajeshwari, Dr.Rajashi Chatterjee

Name of the Module: Mean, quartile and range

Topics in the Module: Data distribution and concept of central tendency and dispersion

Mode of Instruction: Offline

Teaching Pedagogy: **Self-assessment – Assignment**

Assignment Questions:

GAIN MORE KNOWLEDGE REACH GREATER HEIGHTS

Presidency University, Bengaluru
School of Information Science

Department of Mathematics

2022-23 2nd Semester

Course: Statistical Methods and Techniques
Course Code: MAT1006

1. Find the mean, quartiles, mode, coefficient of range, coefficient of quartile deviation and standard deviation for the following data
2, 5, 2, 3, 5, 5, 6, 4, 5, 3, 5, 2, 7, 1.

2. Calculate mean, quartiles, mode, coefficient of range, coefficient of quartile deviation, semi inter quartile and standard deviation for the following data

X	0	10	20	30	40	50	60	70	80
F	4	5	8	11	25	16	12	12	1

3. Find mean, quartiles, mode, coefficient of range, coefficient of quartile deviation and standard deviation for the following data

Classes	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
F	8	11	14	15	18	16	10	8

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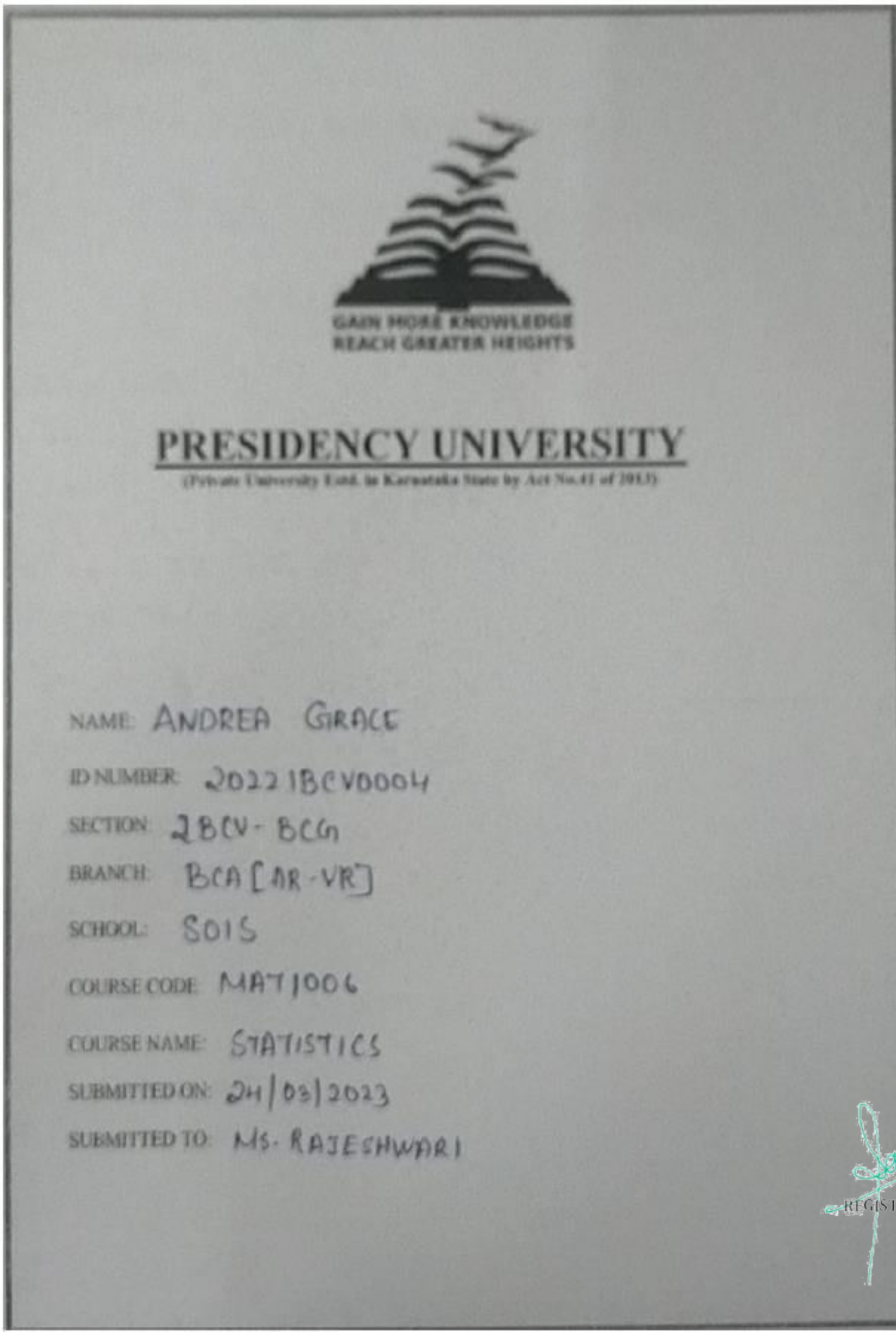
Assignment Sample Copy:



GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

(Private University Estd. in Karnataka State by Act No.41 of 2013)

NAME: ANDREA GRACE

ID NUMBER: 20221BCV0004

SECTION: 2BCV- BCG

BRANCH: BCA [AR-VR]

SCHOOL: SOIS

COURSE CODE: MAT1006

COURSE NAME: STATISTICS

SUBMITTED ON: 24/03/2023

SUBMITTED TO: MS. RAJESHWARI

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MATH ASSIGNMENT

Q. Find the mean, quartile, mode, coefficient of range, coefficient of quartile deviation and standard deviation for the following

2, 5, 2, 3, 5, 5, 6, 4, 5, 3, 5, 2, 7, 1

→ $\bar{x} = \frac{\Sigma f}{n} = \frac{2+5+2+3+5+5+6+4+5+3+5+2+7+1}{14}$

$= \frac{55}{14} = \underline{3.9285}$

In ascending order,

1, 2, 2, 2, 3, 3, 4, 5, 5, 5, 5, 5, 6, 7

→ $Q_1 \rightarrow \frac{r(n+1)}{4} = \frac{1(14+1)}{4} = 3.75$

$Q_1 = 3^{rd} + 0.75\,(4^{th} - 3^{rd})$

$= 2 + 0.75\,(2-2)$

$= \underline{2}$

→ $Q_2 \rightarrow \frac{r(n+1)}{4} = \frac{2(14+1)}{4} = 7.5$

$Q_2 = 7^{th} + 0.5\,(8^{th} - 7^{th})$

$= 4 + 0.5\,(5-4)$

$= \underline{4.5}$

→ $Q_3 \rightarrow \frac{r(n+1)}{4} = \frac{3(14+1)}{4} = 11.25$

$Q_3 = 11^{th} + 0.25\,(12^{th} - 11^{th})$

$= 5 + 0.25\,(5-5)$

$= \underline{5}$

→ Mode = $\underline{5}$

→ Coefficient of range $= \frac{L-S}{L+S} = \frac{7-1}{7+1} = \frac{6}{8} = \underline{0.75}$

→ Coefficient of quartile deviation $= \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{5-2}{5+2} = \frac{3}{7} = \underline{0.4286}$

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→ Standard deviation,

x	x − x̄	$(x-\bar{x})^2$
1	−2.92	8.5264
2	−1.92	3.6864
2	−1.92	3.6864
2	−1.92	3.6864
3	−0.92	0.8464
3	−0.92	0.8464
4	0.08	0.0064
5	1.08	1.1664
5	1.08	1.1664
5	1.08	1.1664
5	1.08	1.1664
5	1.08	1.1664
6	2.08	4.3264
7	3.08	9.4864
		40.9296

$$\sigma = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n}} = \sqrt{\frac{40.9296}{14}} = \sqrt{2.9235} = 1.7098$$

Q2. Calculate mean, quartile, mode, coefficient of range, coefficient of quartile deviation, semi-inter quartile deviation and standard deviation for the following data.

X	0	10	20	30	40	50	60	70	80
F	4	5	8	11	25	16	12	12	1

→ $\bar{x} = \frac{\Sigma xf}{\Sigma f} = \frac{3980}{94} = 42.3404$

x	f	xf	C.F
0	4	0	4
10	5	50	9
20	8	160	17
30	11	330	28
40	25	1000	53
50	16	800	69
60	12	720	81
70	12	840	93
80	1	80	94
	94	3980	

$Q_1 \rightarrow \frac{rN}{4} = \frac{1(94)}{4} = 23.5$

$Q_1 = 30$

$Q_2 \rightarrow \frac{rN}{4} = \frac{2(94)}{4} = 47$

$Q_2 = 40$

$Q_3 \rightarrow \frac{rN}{4} = \frac{3(94)}{4} = 70.5$

$Q_3 = 60$

→ Mode = 40

→ Coefficient of Range $= \frac{L-S}{L+S} = \frac{80-0}{80+0} = 1$

→ Coefficient of quartile deviation $= \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{60-30}{60+30} = \frac{30}{90} = 0.3333$

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Semi-Inter Quartile deviation $= \frac{Q_3 - Q_1}{2} = \frac{60 - 30}{2} = \frac{30}{2} = 15$

For standard deviation,

x	$x-\bar{x}$	$(x-\bar{x})^2$	f	$f(x-\bar{x})^2$
0	-42.34	1792.6756	4	7170.7024
10	-32.34	1045.8756	5	5229.378
20	-22.34	499.0756	8	3992.6048
30	-12.34	152.2756	11	1675.0316
40	-2.34	5.4756	25	136.89
50	7.66	58.6756	16	938.8096
60	17.66	311.8756	12	3742.5072
70	27.66	765.0756	12	9180.9072
80	37.66	1418.2756	1	1418.2756
			94	33485.1064

$$\sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}}$$

$$= \sqrt{\frac{33485.1064}{94}}$$

$$= \sqrt{352.2243}$$

$$= 18.8739$$

Q3 Find mean, quartiles, mode, coefficient of range, coefficient of quartile deviation and standard deviation for the following data.

Classes	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
F	8	11	14	15	18	16	10	8

Class. I	x	f	fx	C.F
10-20	15	8	120	8
20-30	25	11	275	19
30-40	35	14	490	33
40-50	45	15	675	48
50-60	55	18	990	66
60-70	65	16	1040	82
70-80	75	10	750	92
80-90	85	8	680	100
		100	5020	

$\rightarrow \bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{5020}{100} = 50.2$

$Q_1 \rightarrow \frac{rN}{4} = \frac{1(100)}{4} = 25$

C.I = 30-40, $l = 30$, $h = 10$, $f = 14$, C.F = 19

$\rightarrow Q_1 = l + \frac{h}{f}\left(\frac{rN}{4} - C.F\right)$

$= 30 + \frac{10}{14}(25 - 19)$

$= 34.28$

$\rightarrow Q_2 \rightarrow \frac{rN}{4} = \frac{2(100)}{4} = 50$

C.I = 50-60, $l = 50$, $h = 10$, $f = 18$, C.F = 48

$Q_2 = l + \frac{h}{f}\left(\frac{rN}{4} - C.F\right)$

$= 50 + \frac{10}{16}(50 - 48) = 50 + 1.11$

$= 51.11$

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mi-Inter Quartile deviation $= \frac{Q_3 - Q_1}{2} = \frac{60-30}{2} = \frac{30}{2} = \underline{\underline{15}}$

For standard deviation,

x	$x-\bar{x}$	$(x-\bar{x})^2$	f	$f(x-\bar{x})^2$
0	-42.34	1792.6756	4	7170.7024
10	-32.34	1045.8756	5	5229.378
20	-22.34	499.0756	8	3992.6048
30	-12.34	152.2756	11	1675.0316
40	-2.34	5.4756	25	136.89
50	7.66	58.6756	16	938.8096
60	17.66	311.8756	12	3742.5072
70	27.66	765.0756	12	9180.9072
80	37.66	1418.2756	1	1418.2756
			94	33485.1064

$$\sigma = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{N}}$$

$$= \sqrt{\frac{33485.1064}{94}}$$

$$= \sqrt{352.2243}$$

$$= \underline{\underline{18.8739}}$$

Q3 Find mean, quartiles, mode, coefficient of range, coefficient of quartile deviation and standard deviation for the following data.

Classes	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
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70-80	75	10	750	92
80-90	85	8	680	100
		100	5020	

$\rightarrow \bar{x} = \frac{\Sigma fx}{\Sigma f} = \frac{5020}{100} = \underline{\underline{50.2}}$

$Q_1 \rightarrow \frac{rN}{4} = \frac{1(100)}{4} = 25$

C.I = 30-40, $l = 30$, $h = 10$, $f = 14$, C.F = 19

$\rightarrow Q_1 = l + \frac{h}{f}\left(\frac{rN}{4} - C.F\right)$

$= 30 + \frac{10}{14}(25 - 19)$

$= \underline{\underline{34.28}}$

$\rightarrow Q_2 \rightarrow \frac{rN}{4} = \frac{2(100)}{4} = 50$

C.I = 50-60, $l = 50$, $h = 10$, $f = 18$, C.F = 48

$Q_2 = l + \frac{h}{f}\left(\frac{rN}{4} - C.F\right)$

$= 50 + \frac{10}{18}(50-48) = 50 + 1.11$

$= \underline{\underline{51.11}}$

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Submission Records:

Sl. No	Roll Number	Name of the Student
1	20221BCA0010	P SATISH
2	20221BCA0038	APURVA RANJAN SHARAN
3	20221BCA0049	RISHABH SINGH
4	20221BCA0059	KAUSTAV JYOTI BORA
5	20221BCA0071	SHAIK AHAMMAD
6	20221BCA0072	PANYAM LIKITHA
7	20221BCA0088	POTTIPATI THANU SREE SAI
8	20221BCA0091	SUHAS M
9	20221BCA0093	AYUSH KHATRI
10	20221BCA0112	MAHIMA G N
11	20221BCA0130	DEVYANSHI AMESAR
12	20221BCA0145	DIYYA JYOTHI
13	20221BCA0156	MOHD SULEMAN
14	20221BCA0186	VELP MANASA
15	20221BCA0189	SHRUTI KUMARI
16	20221BCA0206	SAMIKSHA GAUTAM
17	20221BCA0225	GUGULOTH DEEPIKA
18	20221BCA0264	SHAIK YASIR AHAMED
19	20221BCA0273	VIJAY PUNIYA
20	20221BCA0282	C BALAGANGADHAR REDDY
21	20221BCA0284	BOLLINI SUSMITHA

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22	20221BCA0287	M CHARISMA
23	20221BCA0313	SAI MANOJ EDIGA
24	20221BCA0316	UMME AMMARAH
25	20221BCA0317	ANAMIKA THETTUMMAL
26	20221BCG0006	ABHHAY SHANKAR
27	20221BCG0012	SHREEJA RAY
28	20221BCV0002	SHREAYAS B
29	20221BCV0004	ANDREA GRACE
30	20221BCV0015	TRISHA S

Total Number of Eligible Students : 30

Total Number of Students Submitted : 25

Signature of Instructor: M.Rjesh

Signature of Instructor In-Charge : M.Rjesh

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HOD - MATHS

SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2021-2022 **Semester: 2ND** **Date: 20-4-2023**

Course Title: DISCRETE MATHEMATICAL STRUCTURES

Course Code: MAT2004

Type of Session: Peer learning

Instructor in Charge: Dr. Naveen Kumar and Dr. V Ramalatha

Instructor for Section: Dr. V Ramalatha

Advanced Learner Instructor for the session: Dr. V Ramalatha

Name of the Module: Mathematical Logic and Predicate Calculus

Topics in the Module: Mathematical Logic and Predicate Calculus

Mode of Instruction: Offline

Teaching Pedagogy: Self-assessment – Assignment

Assignment Questions:

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

Presidency University, Bengaluru
School of Engineering

2022-23 II Semester

Course: Discrete Mathematical Structure (MAT2004)

Assignment 1a

1) "If it rained last night, then the sidewalk is wet". Write converse, inverse and contrapositive this statement.
2) Prove that the statement $(p\rightarrow q) \leftrightarrow (\sim q\rightarrow \sim p)$ is a tautology.
3) Prove that $(p \rightarrow q) \wedge (r \rightarrow q) \Leftrightarrow (p \vee r) \rightarrow q$ is tautology.
4) Prove that conditional and contrapositive are equivalent.
5) Find the PDNF form PCNF of $p \vee (\neg p \rightarrow (q \vee (\neg q \rightarrow r)))$.
6) Find the PDNF form PCNF of $p \vee (\neg p \rightarrow (q \vee (\neg q \rightarrow r)))$.
7) Find the PDNF form PCNF for $(p \leftrightarrow q)$
8) Find the PDNF of $(\neg p \rightarrow r) \wedge (q \leftrightarrow p)$
9) Find the PDNF of $p\wedge\neg(q\wedge r)\vee(p\rightarrow q)$.

Assignment Sample Copy:

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GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

(Private University Estd. in Karnataka State by Act No.41 of 2013)

ASSIGNMENT - 01

NAME: SHAILESH.K.R

ID NUMBER: 20221CAI0075

SECTION: 2-PHY-2 CAI-02

BRANCH: CSE-AIML

SCHOOL: SCHOOL OF ENGINEERING

COURSE CODE: MAT2004

COURSE NAME: DISCRETE MATHEMATICS

SUBMITTED ON:

SUBMITTED TO:

18/5/23

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ASSIGNMENT-01

① If it rained last night, then the side wall is wet. Write converse, inverse and contrapositive of this statement.

Sol:- p: It rained last night
q: The side wall is wet.

Converse:- $q \to p$: If the side walk is wet then it rained last night.

Inverse:- $\neg p \to \neg q$: If it didn't rain last night then the sidewalk is not wet.

Contrapositive:- $\neg q \to \neg p$:- If the side walk is not wet then it didn't rain last night.

② Prove $(p \to q) \leftrightarrow (\neg q \to \neg p)$ is a tautology.

Sol:-

p	q	¬p	¬q	p→q	¬q→¬p
T	T	F	T	T	T
T	F	F	F	F	T
F	T	T	T	T	T
F	F	T	T	T	T

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$(p \to q) \leftrightarrow (\neg q \to \neg p)$
T
T
T
T

$\therefore (p \to q) \leftrightarrow (\neg q \to \neg p)$ is a tautology.

③ Prove that $(p \to q) \wedge (r \to q) \leftrightarrow (p \vee r) \to q$ is tautology.

Sol:

p	q	r	$p \to q$	$r \to q$	$(p \to q) \wedge (r \to q)$
T	T	T	T	T	T
T	T	F	T	T	T
T	F	T	F	F	F
T	F	F	T	T	F
F	T	T	T	T	T
F	T	F	T	T	T
F	F	T	F	F	F
F	F	F	T	T	T

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$p \vee r$	$(p \vee r) \to q$	$(p \to q) \wedge (r \to q) \leftrightarrow (p \vee r) \to q$
T	T	T
T	T	T
T	F	T
T	F	T
T	T	T
F	T	T
T	F	T
F	T	T

$\therefore (p \to q) \wedge (r \to q) \leftrightarrow (p \vee r)$ is a tautology.

④ Prove $p \to q \equiv \neg q \to \neg p$

Ans

	Steps	Reasons
①	$p \to q$	premise
②	$\neg p \vee q$	$p \to \Leftrightarrow \neg p \vee q$
③	$\neg q \to \neg p$	premise
④	$q \vee \neg p$	$\neg p \vee q \Leftrightarrow p \to q$

From ② & ③ $\neg p \vee q \Leftrightarrow q \vee \neg p$

$\therefore p \to q \equiv \neg q \to \neg p$

Hence proved.

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(5) Find PDNF and PCNF of $p\vee(\neg p\rightarrow(q\vee(\neg q\rightarrow r)))$

Soln:-

p	q	r	$\neg p$	$\neg q$	$\neg q\rightarrow r$	$q\vee(\neg q\rightarrow r)$
T	T	T	F	F	T	T
T	T	F	F	T	T	T
T	F	T	F	F	T	T
T	F	F	F	T	F	F
F	T	T	F	F	T	T
F	T	F	T	T	T	T
F	F	T	T	F	T	T
F	F	F	T	T	F	T F

$\neg p\rightarrow(q\vee(\neg q\rightarrow r))$	$p\vee(\neg p\rightarrow(q\vee\neg q\rightarrow r)))$
T	T
T	T
T	T
F	T
T	T
T	T
T	T
F	F

Minterm	Maxterm
$p\wedge q\wedge r$	
$p\wedge q\wedge\neg r$	
$p\wedge\neg q\wedge r$	
$p\wedge\neg q\wedge\neg r$	
$\neg p\wedge q\wedge r$	
$\neg p\wedge q\wedge\neg r$	
$\neg p\wedge\neg q\wedge r$	$p\vee q\vee r$

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∴ PDNF ① $(p \wedge q \wedge r) \vee (p \wedge q \wedge \neg r) \vee (p \wedge \neg q \wedge r) \vee (p \wedge \neg q \wedge \neg r)$
$\vee (\neg p \wedge q \wedge r) \vee (\neg p \wedge q \wedge \neg r) \vee (\neg p \wedge \neg q \wedge r)$

∴ PCNF ② $(p \vee q \vee r)$

⑥ Find PDNF & PCNF of $p \leftrightarrow q$

Soln:

p	q	$p \leftrightarrow q$	Minterm	Maxterm
T	T	T	$p \wedge q$	
T	F	F		$\neg p \vee q$
F	T	F		$p \vee \neg q$
F	F	T	$\neg p \wedge q$	

∴ PDNF is $(p \wedge q) \vee (\neg p \wedge \neg q)$
∴ PCNF is $(\neg p \vee q) \wedge (p \vee \neg q)$

⑦ Find PDNF of $(\neg p \to r) \wedge (q \leftrightarrow p)$

Soln:-

p	q	r	$\neg p$	$\neg p \to r$	$q \leftrightarrow p$	$(\neg p \to r) \wedge (q \leftrightarrow p)$
T	T	T	F	T	T	T
T	T	F	F	T	T	T
T	F	T	F	T	F	F
T	F	F	F	T	F	F
F	T	T	T	T	F	F
F	T	F	F	F	F	F
F	F	T	T	T	T	T
F	F	F	F	F	T	F

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Minterm
$p \wedge q \wedge r$
$p \wedge q \wedge \neg r$
$\neg p \wedge \neg q \wedge r$

$\therefore$ PDNF is $(p \wedge q \wedge r) \vee (p \wedge q \wedge \neg r) \vee (\neg p \wedge \neg q \wedge r)$

(8) Find the PDNF of $p \wedge \neg(q \wedge r) \vee (p \to q)$

Soln:

p	q	r	$q \wedge r$	$\neg(q \wedge r)$	$p \wedge \neg(q \wedge r)$	$p \to q$
T	T	T	T	F	F	T
T	T	F	F	T	T	T
T	F	T	F	T	T	F
T	F	F	F	T	T	F
F	T	T	T	F	F	T
F	T	F	F	T	F	T
F	F	T	F	T	F	T
F	F	F	F	T	F	T

$p\wedge\neg(q\wedge r)\vee(p\rightarrow q)$	Minterms
T	$p\wedge q\wedge r$
T	$p\wedge q\wedge\neg r$
T	$p\wedge\neg q\wedge r$
T	$p\wedge\neg q\wedge\neg r$
T	$\neg p\wedge q\wedge r$
T	$\neg p\wedge q\wedge\neg r$
T	$\neg p\wedge\neg q\wedge r$
T	$\neg p\wedge\neg q\wedge\neg r$

$\therefore$ PDNF is $(p\wedge q\wedge r)\vee(p\wedge q\wedge r)\vee(p\wedge q\wedge r)\vee(p\wedge\neg q\wedge\neg r)$
$\vee(\neg p\wedge q\wedge r)\vee(\neg p\wedge q\wedge\neg r)\vee(\neg p\wedge\neg q\wedge r)\vee(\neg p\wedge\neg q\wedge\neg r)$.

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Submission Records:

Sl. No	Roll Number	Name of the Student
1	SHAILESH K R	20221CAI0064
2	ROHAN S KUMAR	20221CAI0064
3	VAISHNAVI SALUNKE	20221CAI0118
4	ABHIN BEERAPPA VAIDYA	20221CAI0122
5	SHREYA D	20221CAI0071
6	ANANT	20221CAI0079
7	HARISH C	20221CAI0080
8	ROHAN S KUMAR	20221CAI0064

Total Number of Eligible Students : 8

Total Number of Students Submitted : 8

Signature of Instructor: V. Ramalatha

Signature of Instructor In-Charge : V. Ramalatha

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HOD - MATHS

SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2022-2023 **Semester: Lateral Entry 2022 Batch** **Date: 12-03-2023**

Course Title: Mathematics for Engineers

Course Code: MAT2071

Type of Session: Peer learning

Instructor in Charge: Dr. V Ramalatha

Instructor for Section: Dr. V Ramalatha

Advanced Learner Instructor for the session: Dr. V Ramalatha

Name of the Module: Integral transform

Topics in the Module: Laplace transform and z-transform

Mode of Instruction: Offline

Teaching Pedagogy: Self-assessment – Assignment

Assignment Questions:

Assignment Questions

1. Find the inverse Laplace transform of $\dfrac{2s^2-6s+5}{(s-1)(s-2)(s-3)}$
2. Find the inverse Laplace transform of $\dfrac{s-1}{(s+1)(s+2)}$
3. Use Laplace Transform technique to solve $\dfrac{d^2y}{dt^2}+4\dfrac{dy}{dt}+3y=e^{-t}$ with y(0)=y′(0)=0.
4. Use Laplace Transform technique to solve $\dfrac{d^2x}{dt^2}-2\dfrac{dx}{dt}+x=e^{t}$ with x(0)=2,x′(0)=-1
5. Solve $y_{n+2}+2y_{n+1}+y_n=0$ $y_0=0$, $y_1=1$ using z-transform method.
6. Solve $y_{n+2}+6y_{n+1}+y_n=2^n$ $y_0=0$, $y_1=0$ using z-transform method.

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Assignment Sample Copy:

01.

I ASSIGNMENT

01. Find the inverse Laplace transfer of $\frac{2s^2-6s+5}{(s-1)(s-2)(s-3)}$

Soln By partial fraction we can write given as.

$$\frac{2s^2-6s+5}{(s-1)(s-2)(s-3)} = \frac{A}{(s-1)} + \frac{B}{(s-2)} + \frac{C}{(s-3)}$$

$$2s^2-6s+5 = A(s-2)(s-3) + B(s-1)(s-3) + C(s-1)(s-2) \quad ..(1)$$

Put $s = 1$ in (1)

$$2-6+5 = A(1-2)(1-3)$$
$$1 = A(-1)(-2)$$
$$1 = 2A$$
$$\therefore A = \frac{1}{2}$$

Put $s = 2$ in (1)

$$2(4)-6(2)+5 = B(2-1)(2-3)$$
$$8-12+5 = B(1)(-1)$$
$$1 = -1B$$
$$\therefore B = -1$$

Put $s = 3$ in (1)

$$2(9)-6(3)+5 = C[3-1][3-2]$$
$$18-18+5 = C[1][2]$$
$$5 = 2C$$
$$\therefore C = \frac{5}{C}$$

$$\therefore \frac{2s^2-6s+5}{(s-1)(s-2)(s-3)} = \frac{1/2}{s-1} + \frac{(-1)}{s-2} + \frac{5/2}{s-3}$$

Take the inverse Laplace transform of both sides.

$$L^{-1}\left[\frac{2s^2-6s+5}{(s-1)(s-2)(s-3)}\right] = L^{-1}\left[\frac{1/2}{s-1} + \frac{(-1)}{s-2} + \frac{5/2}{s-3}\right]$$

$$= \frac{1}{2}L^{-1}\left[\frac{1}{s-1}\right] - L^{-1}\left[\frac{1}{s-2}\right] + \frac{5}{2}L^{-1}\left[\frac{1}{s-3}\right] \quad \text{(by linearity)}$$

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We have $L^{-1}\left[\frac{1}{s-a}\right] = e^{at}$

$$\therefore L^{-1}\left[\frac{2s^2-6s-5}{(s-1)(s-2)(s-3)}\right] = \frac{1}{2}e^{t} - e^{2t} + \frac{5}{2}e^{3t}$$

Thus $\mathcal{L}^{-1}\left[\frac{2s^2-6s-5}{(s-1)(s-2)(s-3)}\right] = f(t) = \frac{1}{2}e^{t} - e^{2t} + \frac{5}{2}e^{3t}$.

Q2. Find the inverse Laplace transform of $\frac{s-1}{(s+1)(s+2)}$

Soln: By partial fraction we can write the given as:

$$\frac{s-1}{(s+1)(s+2)} = \frac{A}{(s+1)} + \frac{B}{(s+2)}$$

$$= s-1 = A(s+2) + B(s+1) \quad \ldots(1)$$

Put $s = -2$ in (1)

$-2-1 = A(0) + B(-2+1)$

$-3 = -B$

$\therefore B = 3$

Put $s = -1$ in (1)

$-1-1 = A(-1+2) + B(0)$

$-2 = A$

$\therefore A = -2$

$$\therefore \frac{s-1}{(s+1)(s+2)} = \frac{-2}{(s+1)} + \frac{3}{(s+2)}$$

Take inverse Laplace transform on both sides.

$$L^{-1}\left[\frac{s-1}{(s+1)(s+2)}\right] = L^{-1}\left[\frac{-2}{(s+1)} + \frac{3}{(s+2)}\right]$$

$$= -2L^{-1}\left\{\frac{1}{s+1}\right\} + 3L^{-1}\left\{\frac{1}{s+2}\right\}$$

We have $L^{-1}\left[\frac{1}{s+a}\right] = e^{-at}$

$$\therefore L^{-1}\left[\frac{s-1}{(s+1)(s+2)}\right] = -2e^{-t} + 3e^{-2t}.$$

03) Use Laplace transform technique to solve

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 3y = e^{-t} \text{ with } y(0) = y'(0) = 0$$

sol^n Given $y''(t) + 4y'(t) + 3y(t) = e^{-t}$

Taking the Laplace transform on both sides

$$L[y''(t)] + 4L[y'(t)] + 3L[y(t)] = L[e^{-t}]$$

Using $L[y''(t)] = s^2\bar{y}(s) - sy(0) - y'(0)$, $L[y'(t)] = s\bar{y}(s) - y(0)$

$L[y(t)] = \bar{y}(s)$ and $L[e^{-at}] = \frac{1}{s+a}$ we get

$$[s^2\bar{y}(s) - sy(0) - y'(0)] + 4[s\bar{y}(s) - y(0)] + 3\bar{y}(s) = \frac{1}{s+1}$$

Using initial conditions $y(0) = 0$ & $y'(0) = 0$, the above reduces to : $s^2\bar{y}(s) + 4s\bar{y}(s) + 3\bar{y}(s) = \frac{1}{s+1}$

$$(s^2 + 4s + 3)\bar{y}(s) = \frac{1}{s+1}$$

$$(s+1)(s+3)\bar{y}(s) = \frac{1}{s+1}$$

$$\therefore \bar{y}(s) = \frac{1}{(s+1)^2(s+3)}$$

Take the inverse Laplace transform on both sides

$$L^{-1}[\bar{y}(s)] = y(t) = L^{-1}\left[\frac{1}{(s+1)^2(s+3)}\right] \quad \ldots (i)$$

Let $\frac{1}{(s+1)^2(s+3)} = \frac{A}{(s+1)} + \frac{B}{(s+1)^2} + \frac{C}{s+3}$ partial fraction

$\therefore$

$$1 = A(s+1)(s+3) + B(s+3) + C(s+1)^2 \quad \ldots (ii)$$

Put $s = -1$ in (2)	Put $s = -3$ in (2)
$1 = A(0) + B(-1+3) + C(0)$	$1 = A(0) + B(0) + C[-3+1]^2$
$1 = 2B$	$1 = C[4]$
$\therefore B = \frac{1}{2}$	$\therefore C = \frac{1}{4}$

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Put $s = 0$ in (2)

$1 = 3A + 3B + C$

$1 = 3A + 3\left[\frac{1}{2}\right] + \frac{1}{4} = 3A + \frac{7}{4}$

$3A = 1 - \frac{7}{4} = \frac{-3}{4} \quad \therefore A = \frac{-1}{4}$

$\therefore$

$$\frac{1}{(s+1)^2(s+3)} = \frac{-1/4}{(s+1)} + \frac{1/2}{(s+1)^2} + \frac{1/4}{s+3}$$

· Using the above in (i) we get

$$y(t) = L^{-1}\left[\frac{1}{(s+1)^2(s+3)}\right] = L^{-1}\left[\frac{-1/4}{(s+1)} + \frac{1/2}{(s+1)^2} + \frac{1/4}{(s+3)}\right]$$

$$y(t) = -\frac{1}{4}L^{-1}\left[\frac{1}{s+1}\right] + \frac{1}{2}L^{-1}\left[\frac{1}{(s+1)^2}\right] + \frac{1}{4}L^{-1}\left[\frac{1}{s+3}\right]$$

Then, We have $L^{-1}\left[\frac{1}{s+a}\right] = e^{-at}$ and $L^{-1}\left[\bar{f}(s+a)\right] = e^{-at}L^{-1}\left[\bar{f}(s)\right]$

$$\therefore y(t) = -\frac{1}{4}e^{-(1)t} + \frac{1}{2}e^{-(1)t}L^{-1}\left[\frac{1}{s^2}\right] + \frac{1}{4}e^{-3t}$$

We have $L^{-1}\left[\frac{1}{s^n}\right] = \frac{t^{n-1}}{(n-1)!}$

$$\therefore y(t) = -\frac{1}{4}e^{-t} + \frac{1}{2}e^{-t}\left[\frac{t^{2-1}}{(2-1)!}\right] + \frac{1}{4}e^{-3t}$$

$$= \frac{-1}{4}e^{-t} + \frac{1}{2}e^{-t}\left(\frac{t}{1}\right) + \frac{1}{4}e^{-3t}$$

Thus, we get :

$$y(t) = \left[\frac{t}{2} - \frac{1}{4}\right]e^{-t} + \frac{1}{4}e^{-3t}.$$

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Q4 Apply Laplace transform technique to solve $\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + x = e^t$ with $x = 2$, $\frac{dx}{dt} = -1$ at $t = 0$.

Soln: Given $x''(t) - 2x'(t) + x(t) = e^t$

Taking Laplace transform on both sides

$$L[x''(t)] - 2L[x'(t)] + L[x(t)] = L[e^t]$$

using $L[x''(t)] = s^2\bar{x}(s) - sx(0) - x'(0)$

$L[x'(t)] = s\bar{x}(s) - x(0)$ and $L[x(t)] = \bar{x}(s)$, we get

$$[s^2\bar{x}(s) - sx(0) - x'(0)] - 2[s\bar{x}(s) - x(0)] + \bar{x}(s) = \frac{1}{s-1}$$

Using the initial condition $x(0) = 2$ and $x'(0) = -1$, the above reduces to

$$[s^2\bar{x}(s) - s(2) - (-1)] - 2[s\bar{x}(s) - 2] + \bar{x}(s) = \frac{1}{s-1}$$

$$(s^2 - 2s + 1)\bar{x}(s) - 2s + 5 = \frac{1}{s-1}$$

$$(s^2 - 2s + 1)\bar{x}(s) = \frac{1 + (2s^2 - 7s + 5)}{s-1} = \frac{2s^2 - 7s + 6}{s-1}$$

$$\therefore \bar{x}(s) = \frac{2s^2 - 7s + 6}{(s-1)^3}$$

Take the Laplace transform on both sides.

$$L^{-1}[\bar{x}(s)] = x(t) = L^{-1}\left[\frac{2s^2 - 7s + 6}{(s-1)^3}\right] \quad \ldots (1)$$

$$\frac{2s^2 - 7s + 6}{(s-1)^3} = \frac{A}{s-1} + \frac{B}{(s-1)^2} + \frac{C}{(s-1)^3}$$

$$\therefore 2s^2 - 7s + 6 = A(s-1)^2 + B(s-1) + C.$$

$$2s^2 - 7s + 6 = As^2 - 2As + A + Bs - B + C \quad \ldots (2)$$

Comparing the co efficient of s^2 in (2), we get

$2 = A$ $\therefore A = 2$

Comparing the co efficient of s in (2), we get

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$$-7 = -2A + B$$
$$-7 = -2(2) + B$$
$$\therefore B = -7+4 = -3$$

Comparing the constants in (2), we get

$$6 = A - B + C$$
$$6 = 2-(-3)+C$$
$$C = 1$$

$$\therefore \frac{2s^2-7s+6}{(s-1)^3} = \frac{2}{(s-1)} + \frac{-3}{(s-1)^2} + \frac{1}{(s-1)^3}$$

Using the above in (1) we get

$$x(t) = L^{-1}\left[\frac{2s^2-7s+6}{(s-1)^3}\right] = L^{-1}\left[\frac{2}{s-1} + \frac{-3}{(s-1)^2} + \frac{1}{(s-1)^3}\right]$$

$$x(t) = 2L^{-1}\left[\frac{1}{s-1}\right] - 3L^{-1}\left[\frac{1}{(s-1)^2}\right] + L^{-1}\left[\frac{1}{(s-1)^3}\right]$$

$$\therefore x(t) = 2e^{(1)t} - 3e^{(1)t}L^{-1}\left\{\frac{1}{s^2}\right\} + e^{(1)t}L^{-1}\left[\frac{1}{s^3}\right]$$

We have $L^{-1}\left[\frac{1}{s^n}\right] = \frac{t^{n-1}}{(n-1)!}$

$$\therefore y(t) = 2e^t - 3e^t\left[\frac{t^{2-1}}{(2-1)!}\right] + e^t\left[\frac{t^{3-1}}{(3-1)!}\right]$$

$$= 2e^t - 3e^t\left[\frac{t}{1!}\right] + e^t\left[\frac{t^2}{2!}\right]$$

$$= 2e^t - 3t\,e^t + \frac{t^2}{2}\,e^t$$

we get, thus $x(t) = \left[2 - 3t + \frac{t^2}{2}\right]e^t$.

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05. Solve $y_{n+2} + 2y_{n+1} + y_n = 0$ with $y_0 = 0$, $y_1 = 1$. using Z transformation method.

Soln: Given $y_{n+2} + 2y_{n+1} + y_n = 0$

Taking Z transformation on both sides

$$Z[y_{n+2}] + 2Z[y_{n+1}] + Z[y_n] = 0 \quad \cdots (1)$$

$$Z^2[Z(y_n) - y_0 - y_1 Z^{-1}] + 2Z[Z(y_n) - y_0] + Z[y_n] = 0$$

taking $Z[y_n] = y[z]$

$$Z^2[y(z) - (0) - (1)\, 1/z] + 2z[y(z) - (0)] + y(z) = 0$$

$$(z^2 + 2z + 1)y(z) - z = 0$$

$$(z^2 + 2z + 1)\, y(z) = z$$

$$\therefore \quad y(z) = \frac{z}{(z^2+2z+1)} = \frac{z}{(z+1)^2}$$

take inverse Z transformation on both sides

$$Z^{-1}[y(z)] = Z^{-1}\left[\frac{z}{(z+1)^2}\right]$$

$$y_n = Z^{-1}\left[\frac{z}{(z+1)^2}\right]$$

We know that $Z^{-1}\left[\frac{az}{(z-a)^2}\right] = a^n n$

$$y_n = \frac{-1}{-1} Z^{-1}\left[\frac{z}{(z-(-1))^2}\right]$$

$$y_n = -Z^{-1}\left[\frac{-1z}{[z-(-1)]^2}\right]$$

$$\therefore y_n = -[-1]^n n$$

$$= (-1)(-1)^n n$$

$$= (-1)^{n+1} n.$$

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06) Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$, using Z-transformation method.

Soln: Given - $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$.

Take Z transformation on both side

$$Z[y_{n+2}] + 6Z[y_{n+1}] + 9Z[y_n] = Z[2^n] \quad \dots (1)$$

$$Z^2[Z(y_n) - y_0 - y_1 Z^{-1}] + 6Z[Z(y_n) - y_0] + 9Z(y_n) = \frac{Z}{Z-2}$$

Taking $Z[y_n] = y(Z)$

$$Z^2\left[y(Z) - (0) - (0)\frac{1}{Z}\right] + 6Z[y(Z) - (0)] + 9y(Z) = \frac{Z}{Z-2}$$

$$Z^2 y(Z) + 6Zy(Z) + 9y(Z) = \frac{Z}{Z-2}$$

$$(Z^2 + 6Z + 9)\, y(Z) = \frac{Z}{Z-2}$$

$$y(Z) = \frac{Z}{(Z-2)(Z+3)^2}$$

$$\frac{y(Z)}{(Z)} = \frac{1}{(Z-2)(Z+3)^2} \quad \dots (2)$$

By partial fraction, we can write as

$$\frac{1}{(Z-2)(Z-3)^2} = \frac{A}{(Z-2)} + \frac{B}{(Z+3)} + \frac{C}{(Z+3)^2}$$

$$\frac{1}{(Z-2)(Z-3)^2} = \frac{A(Z+3)^2 + B(Z-2)(Z+3) + C(Z-2)}{(Z-2)(Z+3)^2}$$

$$\therefore 1 = A(Z+3)^2 + B(Z-2)(Z+3) + C(Z-2)$$

Putting Z as −3, we get

$$1 = 0 + 0 - 5C$$

$$\therefore C = -1/5.$$

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Putting $z = 2$; $1 = 25A + 0 + 0$

$$A = \frac{1}{25}$$

→ Co-efficient of z^2, $0 = A + B$; $B = \frac{-1}{25}$.

$$\therefore \frac{1}{(z-2)(z+3)^2} = \frac{1/25}{(z-2)} + \frac{-1/25}{(z+3)} + \frac{-1/5}{(z+3)^2}$$

using eqn (3) in (2) we get

$$\frac{y(z)}{z} = \frac{1/25}{(z-2)} + \frac{-1/25}{(z+3)} + \frac{-1/5}{(z+3)^2}$$

$$\therefore y(z) = z\left[\frac{1/25}{(z-2)} + \frac{-1/25}{(z+3)} + \frac{-1/5}{(z+3)^2}\right]$$

$$y(z) = \frac{1}{25}\left[\frac{z}{(z-2)} - \frac{1}{25}\frac{z}{(z+3)} - \frac{1}{5}\frac{z}{(z+3)^2}\right]$$

$$y(z) = \frac{1}{25}\left[\frac{z}{(z-2)} - \frac{z}{(z+3)} - 5\frac{z}{(z+3)^2}\right]$$

Taking inverse z transformation on both sides

$$Z^{-1}[y(z)] = \frac{1}{25} Z^{-1}\left[\frac{z}{(z-2)} - \frac{z}{(z+3)} - 5\frac{z}{(z+3)^2}\right]$$

We know that $Z^{-1}\left[\frac{z}{z+a}\right] = (-a)^n$; $Z^{-1}\left[\frac{z}{z-a}\right] = a^n$; $Z^{-1}\left[\frac{az}{(z-a)^2}\right] = a^n n$

$$\therefore y_n = \frac{1}{25}\left[2^n - (-3)^n - 5\frac{(-3)}{(-5)} Z^{-1}\left[\frac{z}{(z+3)^2}\right]\right]$$

$$y_n = \frac{1}{25}\left[2^n - (-3)^n + \frac{5}{3} Z^{-1}\left[\frac{z}{(z+3)^2}\right]\right]$$

$$y_n = \frac{1}{25}\left[2^n - (-3)^n + 5/3\,(-3)^n n\right]$$

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Submission Records:

Sl. No	Roll Number	Name of the Student
1	20221LCA0005	M K DARSHAN
2	20221LCA0006	MOHAMMED EISA
3	20221LCA0007	MAHESH M C
4	20221LCA0008	KUSHAL MP
5	20221LCS0009	VIJAYKUMAR VITTAL GUGGARI
6	20221LCS0010	GURUPRASAD V
7	20221LCS0011	SRIKANTH GOWDA N

Total Number of Eligible Students : 7

Total Number of Students Submitted : 5

Signature of Instructor: V. Ramalatha

Signature of Instructor In-Charge : V. Ramalatha

HOD - MATHS

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GAIN MORE KNOWLEDGE
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Private University Estd. in Karnataka State by Act No. 41 of 2013

SCHOOL of ENGINEERING
DEPARTMENT OF MATHEMATICS

Year: 2022-2023 **Semester: 2nd** **Date: 31-05-2023**

Course Title: Operation Research

Course Code: BSE2006

Type of Session: Participative learning

Instructor in Charge: Dr. Maisha Chaudhary

Instructor for Section: Dr. Maisha Chaudhary

Advanced Learner Instructor for the session: Dr. Maisha Chaudhary

Name of the Module: Module 4

Topics in the Module: Vogel's Approximation Method
Mode of Instruction: Offline

Teaching Pedagogy: Self-assessment – Assignment

Assignment Questions:

1. Discuss the 10 applications Interpolation, Numerial Integration
2. Explain the importance of numerical solution of ordinary differential equations and partial differential equations.
3. Evaluate

a. $\int_0^1 \frac{x}{(1+x)} dx$ b. $\int_1^2 \frac{x^2}{(1+x)^2} dx$ using Trapezoidal Rule and both Simpson's Rules

4. Using modified Euler's method find y at $x = 0.2$, given $6\frac{dy}{dx} = x^2 - y^2$ with $y(0) = 1$ & $h = 0.1$

5. Using Runge-Kutta method of order 4, find y at $x = 0.2$, given $\frac{dy}{dx} = \frac{x+y}{x-y}$ with $y(0) = 1$ & $h = 0.1$

6. Consider the initial value problem $\frac{dy}{dx} = x - y^2 + 1$, y(0) = 0.3. Predict y(0.2) by using the Runge-Kutta method.

6. Using Lagrage's Interpolation method estimate y at x=1.4 for the following data.

x	1	2	4	7
y	0	3	12	7

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Assignment Sample Copy:

Assignment - 2

(1) Discuss the 10 applications Interpolation, Numerical Integration.

Application of Interpolation:-

* It is used to estimate and predict the data
* The primary use of interpolation is to help users, be they scientists, photographers, engineers or mathematicians, determine what data might exist outside of their collected data.

Outside the domain of mathematics, interpolation is frequently used to scale image and to convert the sampling rate of digital Signals.

It is used to calculate the unknown heights of intrested points by reffering to the elevation information of neighboring points.

Interpolation is about calculating function's value based on the value of other datapoints in a given Sequence. To solve complex heat transfer problems involving mechanism such as conduction, convection, radiation, or combination of them.

Applications of Numerical Integration

Numerical Integration is a computational approach of evaluating definite integrals. Numerical Integration has a lot of applications in engineering such as in computation of areas, volumes, and surfaces. It also has the advantage of being easily programmable in computer software.

It helps to find sectional area, waterplane area, submerged volume, longitudinal center of floatation, vertical center of buoyancy (VCB).

In real life Integration was used to design the Petronas Towers making it stronger. Many differential equations were used in the designing of the Sydney opera house.

It is used to find center of mass, displacement, velocity and fluid flow.

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(2) Explain the importance of numerical solution of ordinary differential equations and partial differential equations.

Sol * Partial differential equations are used to mathematically formulate, and thus aid the solution of, physical and other problems involving functions of several variables such as the propagation of heat, sound, fluid flow, elasticity, electrostatics and electrodynamics.

* Numerical methods provide a way to solve problem quickly and easily compared to analytic solutions. whether the goal is integration or solution of complex differential equations, there are many tools available to reduce the solution of what we can be sometimes quite difficult analytical math to simple algebra.

* ordinary differential equations and elliptic partial differential equations are used to illustrate the approach to quantify uncertainty in both the statistical analysis of the forward and inverse problems. For many physical systems, one can, subject to suitable idealization, formulate a differential equation.

(3)

(a) $\int_0^1 \frac{x}{(1+x)} dx$ using Trapezoidal and Simpson's Rule

Sol

let $I = \int_0^1 \frac{x}{1+x} dx$ Here $f(x) = \frac{x}{1+x}$; $a=0$; $b=1$

$h = \frac{b-a}{n} = \frac{1-0}{6} = \frac{1}{6}$ $\boxed{h=\frac{1}{6}}$

x	0	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	1
$y=f(x)$	0	$\frac{1}{7}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{2}{5}$	$\frac{5}{11}$	$\frac{1}{2}$
	0	0.143	0.25	0.333	0.400	0.455	0.5
	y_0	y_1	y_2	y_3	y_4	y_5	y_6

1) Trapezoidal rule.

W.K.T

$$\int_a^b f(x) dx = \frac{h}{2}\left[(F.T + L.T) + 2(\text{remaining terms})\right]$$

$$= \frac{1}{6}\left(\frac{1}{2}\right)\left[(y_0+y_6) + 2(y_1+y_2+y_3+y_4+y_5)\right]$$

$$= \frac{1}{12}\left[(0+0.5) + 2(0.143+0.25+0.333+0.4 + 0.455)\right]$$

$$= \frac{1}{12}\left[0.5 + 3.162\right)$$

$= 0.305$

$$\int_0^1 \frac{x}{1+x}\,dx = 0.305$$

Simpson's $\frac{1}{3}$rd rule

w.k.T.

$$\int_a^b f(x)\,dx = \frac{h}{3}\Big[(F.T + L.T) + 4(\text{sum of odd terms}) + 2(\text{sum of even terms})\Big]$$

$$\int_0^1 \frac{x}{1+x}\,dx = \frac{1}{6}\left(\frac{1}{3}\right)\Big[(y_0+y_6) + 4(y_1+y_3+(y_5)) + 2(y_2+y_4)\Big]$$

$$= \frac{1}{18}\Big[(0+0.5) + 4(0.143+0.333+0.455) + 2(0.25+0.400)\Big]$$

$$= \frac{1}{18}\Big[0.5 + 3.724 + 1.3\Big]$$

$$= 0.307$$

$$\int_0^1 \frac{x}{1+x}\,dx = 0.307$$

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Simpson's $\frac{3}{8}$th rule

$$\int_a^b f(x)\,dx = \frac{3h}{8}\Big[(F.T + L.T) + 2(\text{mutiple of 3 terms}) + 3(\text{remaining terms})\Big]$$

$$\int_0^1 \frac{x}{1+x}\,dx = \frac{3}{8}\left(\frac{1}{6}\right)\Big[(y_0 + y_6) + 2[y_3] + 3[y_1 + y_2 + y_4 + y_5]\Big]$$

$$= \frac{3}{8}\left(\frac{1}{6}\right)\Big[(0 + 0.5) + 2(0.333) + 3(0.143 + 0.25 + 0.4 + 0.455)\Big]$$

$$= \frac{1}{16}\Big[0.5 + 0.666 + 3.744\Big]$$

$$\boxed{\int_0^1 \frac{x}{1+x}\,dx = 0.307}$$

(6) $\int_1^2 \frac{x^2}{(1+x)^2} dx$ using Trapezoidal Rule and Simpson's Rule.

Sol: let $I = \int_1^2 \frac{x^2}{(1+x)^2} dx$ Here $f(x) = \frac{x^2}{(1+x)^2}$, $a=1$; $b=2$

$h = \frac{b-a}{n} = \frac{2-1}{6} = \frac{1}{6}$. $\boxed{h = \frac{1}{6}}$

x	1	$\frac{7}{6}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{11}{6}$	2
y	$\frac{1}{4}$	$\frac{49}{169}$	$\frac{16}{49}$	$\frac{9}{25}$	$\frac{25}{64}$	$\frac{121}{289}$	$\frac{4}{9}$
	0.25	0.290	0.327	0.36	0.391	0.419	0.444
	y_0	y_1	y_2	y_3	y_4	y_5	y_6

1) Trapezoidal rule.

w.k.t

$\int_a^b f(x)dx = \frac{h}{2}\left[(F.T + L.T) + 2(\text{remaining terms})\right]$

$= \frac{1}{6}\left(\frac{1}{2}\right)\left[(y_0+y_6) + 2(y_1+y_2+y_3+y_4+y_5)\right]$

$= \frac{1}{12}\left[(0.25+0.444) + 2(0.290+0.327+0.36+0.391+0.419)\right]$

$= \frac{1}{12}\left[0.694 + 3.574\right] = 0.356.$

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$$\int_1^2 \frac{x^2}{(1+x)^2} dx = 0.356$$

2) Simpson's $\frac{1}{3}$rd Rule.

$$\int_a^b f(x)\,dx = \frac{h}{3}\Big[(F.T + L.T) + 4(\text{sum of odd terms}) + 2(\text{sum of even terms})\Big]$$

$$= \frac{1}{3\times 6}\Big[(y_0 + y_6) + 4(y_1 + y_3 + y_5) + 2(y_2 + y_4)\Big]$$

$$= \frac{1}{18}\Big[(0.25 + 0.444) + 4(0.290 + 0.36 + 0.419) + 2(0.327 + 0.391)\Big]$$

$$= \frac{1}{18}\Big[0.694 + 4.276 + 1.436\Big]$$

$$= 0.356$$

$$\int_1^2 \frac{x^2}{(1+x)^2} dx = 0.356$$

3) Simpson's $\frac{3}{8}$th Rule.

$$\int_a^b f(x)\,dx = \frac{3h}{8}\Big[(F.T + L.T) + 2(\text{multiple of 3 terms}) + 3(\text{remaining terms})\Big]$$

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$$\int_1^2 \frac{x^2}{(1+x)^2}\,dx = \frac{3}{8}\left(\frac{1}{6}\right)\left[(y_0+y_6)+2(y_3)+3(y_1+y_2+y_4+y_5)\right]$$

$$= \frac{1}{16}\left[(0.25+0.444)+2(0.36)+3(0.290+0.327+0.391+0.419)\right]$$

$$= \frac{1}{16}\left[0.694+0.720+4.281\right]$$

$$= 0.356.$$

$$\boxed{\int_1^2 \frac{x^2}{(1+x)^2}\,dx = 0.356}$$

(4) Using modified Euler's method find y at $x=0.2$, given $6\frac{dy}{dx} = x^2-y^2$ with $y(0)=1$; $h=0.1$

Sol

$\frac{dy}{dx} = y' = \frac{x^2-y^2}{6}$ with $y(0)=1$

$y(x_0) = y_0$

$x_0 = 0$; $y_0 = 1$

i.e $f(x,y) = \frac{x^2-y^2}{6}$; $h = 0.1$

we need to find y at $x=0.2$ by considering $h=0.1$

w.k.t $x_1 = x_0 + h$

$x_1 = 0+0.1$

$\boxed{x_1 = 0.1}$

By Euler's formula

$y_1 = y_0 + h(f(x_0,y_0))$

$f(x_0,y_0) = f(0,1) = \frac{0^2-1^2}{6} = \frac{-1}{6} = -0.167$

$y_1 = 1+0.1(-0.167)$

$\boxed{y_1 = 0.983}$

from modified Euler's formula we have.

first modified value of y_1 is given by.

$$y_1^{(1)} = y_0 + \frac{h}{2}\left[f(x_0, y_0) + f(x_1, y_1)\right]$$

$$f(x_1, y_1) = f(0.1, 0.983) = \frac{(0.1)^2 - (0.983)^2}{6} = -0.159$$

$$y_1^{(1)} = 1 + \frac{0.1}{2}\left[-0.167 - 0.159\right].$$

$$\boxed{y_1^{(1)} = 0.984}$$

By second modified value of y_1 is given by.

$$y_1^{(2)} = y_0 + \frac{h}{2}\left(f(x_0, y_0) + f(x_1, y_1^{(1)})\right)$$

$$f(x_1, y_1^{(1)}) = f(0.1, 0.984) = \frac{(0.1)^2 - (0.984)^2}{6} = -0.160$$

$$y_1^{(2)} = 1 + \frac{0.1}{2}\left[-0.167 - 0.160\right].$$

$$\boxed{y_1^{(2)} = 0.984}$$

$$\boxed{y(0.1) = 0.984}$$

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Stage (ii)

we got $y(0.1) = 0.984$

$x_0 = 0.1$; $y_0 = 0.984$

$x_1 = x_0 + h$; $x_1 = 0.1 + 0.1 = 0.2$

$$f(x_0, y_0) = f(0.1, 0.984) = \frac{(0.1)^2 - (0.984)^2}{6} = -0.160$$

By Euler's formula

$$y_1 = y_0 + hf(x_0, y_0)$$

$$= 0.984 + 0.1(-0.160)$$

$$\boxed{y_1 = 0.968}$$

By first modified Euler's value of y_1 is given by

$$y_1^{(1)} = y_0 + \frac{h}{2}\left(f(x_0, y_0) + f(x_1, y_1)\right)$$

$$f(x_1, y_1) = f(0.2, 0.968) = \frac{(0.2)^2 - (0.968)^2}{6} = -0.150$$

$$y_1^{(1)} = 0.984 + \frac{0.1}{2}(-0.160 - 0.150)$$

$$\boxed{y_1^{(1)} = 0.969}$$

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By second modified Euler's value of y is given by

$$y_1^{(2)} = y_0 + \frac{h}{2}\left(f(x_0, y_0) + f(x_1, y_1^{(1)})\right)$$

$$f(x_1, y_1^{(1)}) = f(0.2, 0.969) = \frac{(0.2)^2 - (0.969)^2}{6} = -0.150.$$

$$y_1^{(2)} = 0.984 + \frac{0.1}{2}(-0.160 - 0.150)$$

$$\boxed{y_1^{(2)} = 0.969}$$

∴ The required solution of $y(0.2) = 0.969$

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⑤ Using Runge-Kutta method of fourth order, find y at $x = 0.1$, given $\frac{dy}{dx} = \frac{x+y}{x-y}$ with $y(0) = 1$ and $h = 0.1$

Sol

Given, $\frac{dy}{dx} = \frac{x+y}{x-y}$ with $y(0) = 1$ $y(x_0) = y_0$

and $h = 0.1$ $x_0 = 0$; $y_0 = 1$

$f(x_0, y_0) = (0, 1) = \frac{0+1}{0-1} = -1$

$f(x_0, y_0) = -1$

$K_1 = hf(x_0, y_0)$

$= 0.1(-1)$

$K_1 = -0.1$

$K_2 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{K_1}{2}\right)$

$f\left(0 + \frac{0.1}{2}, 1 + \frac{(-0.1)}{2}\right) = f(0.05, 0.95) = \frac{0.05 + 0.95}{0.05 - 0.95}$

$= -1.111$

$K_2 = 0.1(-1.111)$

$K_2 = -0.111$

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$k_3 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right)$

$f\left(0 + \frac{0.1}{2}, 1 + \frac{(-0.111)}{2}\right) = f(0.05, 0.945) = \frac{0.05 + 0.945}{0.05 - 0.945}$

$= -1.112$

$k_3 = 0.1(-1.112)$

$k_3 = -0.111$

$k_4 = hf(x_0 + h, y_0 + k_3)$

$f(0 + 0.1, 1 + (-0.111)) = f(0.1, 0.889) = \frac{0.1 + 0.889}{0.1 - 0.889}$

$f(0.1, 0.889) = -1.253$

$k_4 = 0.1(-1.253)$

$k_4 = -0.125$

where

$y(x_0 + h) = y_0 + \frac{1}{6}[k_1 + 2k_2 + 2k_3 + k_4]$

$= 1 + \frac{1}{6}[-0.1 + 2(-0.111) + 2(-0.111) + (0.125)]$

$y(0 + 0.1) = 0.889$

$y(0.1) = 0.889$

stage-2

$y(0.1) = 0.889.$

$x_0 = 0.1 \; ; \; y_0 = 0.889$

$f(x,y) = \dfrac{x+y}{x-y} \; ; \; h = 0.1$

$x_1 = x_0 + h$

$x_1 = 0.1 + 0.1 = 0.2$

$k_1 = hf(x_0, y_0)$

$f(0.1, 0.889) = \dfrac{(0.1) + 0.889}{0.1 - 0.889}$

$k_1 = 0.1(-1.203)$

$k_1 = -0.120$

$k_2 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right)$

$f\left(0.1 + \frac{0.1}{2}, 0.889 + \frac{(-0.120)}{2}\right)$

$f(0.150, 0.829) = \dfrac{0.15 + 0.827}{0.15 - 0.827} = -1.443$

$k_2 = 0.1(-1.443)$

$k_2 = -0.144$

$k_3 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right) = f\left(0.1 + \frac{0.1}{2}, 0.889 + \frac{(-0.1}{2}\right.$

$= f(0.150, 0.817) = \dfrac{0.15 + 0.817}{0.15 - 0.817} = -1.450.$

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$k_3 = 0.1(-1.450)$

$k_3 = -0.145$

$k_4 = hf(x_0+h, y_0+k_3)$

$f(0.1+0.1, 0.889+(-0.145)) = f(0.2, 0.744)$

$= \frac{0.2+0.744}{0.2-0.744} = -1.735$

$k_4 = 0.1(-1.735)$

$k_4 = -0.174$

where

$y(x_0+h) = y_0 + \frac{1}{6}(k_1+2k_2+2k_3+k_4)$

$y(0.1+0.1) = 0.889 + \frac{1}{6}[-0.125+2(-0.149)+2(-0.145)+(-0.174)]$

$y(0.2) = 0.743$

The required solution of $y(0.2)$ is 0.743.

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⑥ Consider the initial value of problem $\frac{dy}{dx} = x^2 - y^2 + 1$; $y(0) = 0.3$; predict $y(0.2)$ by using the Runge kutta method.

Sol: Given, $\frac{dy}{dx} = x^2 - y^2 + 1$; $y(0) = 0.3$

with $x_0 = 0$; $y_0 = 0.3$.

let consider $h = 0.2$;

$f(x,y) = x^2 - y^2 + 1$

$k_1 = hf(x_0, y_0)$ $\Rightarrow f(x_0; y_0) = f(0, 0.3) = 0^2 - (0.3)^2 + 1$

$= 0.910$

$k_1 = 0.2(0.910)$

$k_1 = 0.182$

$k_2 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right)$

$f\left(0 + \frac{0.2}{2}, 0.3 + \frac{0.182}{2}\right) = f(0.1, 0.391) = (0.1)^2 - (0.391)^2 + 1$

$= 0.9\ldots$

~~$k_2 = 0.2(0.\ldots)$~~ $k_2 = 0.2(0.947)$

$k_2 = 0.189$

$k_3 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right)$

$f\left(0 + \frac{0.2}{2}, 0.3 + \frac{0.190}{2}\right) = f(0.1, 0.395)$

$= 0.1 - (0.395)^2 + 1 = 0.944$

$k_3 = 0.2(0.944)$ $\boxed{k_3 = 0.189}$

$k_4 = hf(x_0 + h, y_0 + k_3) = f(0 + 0.2, 0.3 + 0.189)$

$f(0.2, 0.489) = 0.2 - (0.489)^2 + 1 = 0.961$

$k_4 = 0.2 \times (0.961) = 0.192 = \boxed{k_4 = 0.192}$

where

$y(x_0 + h) = y_0 + \frac{1}{6}\left[k_1 + 2k_2 + 2k_3 + k_4\right]$

$y(0 + 0.2) = 0.3 + \frac{1}{6}\left[0.182 + 2(0.189) + 2(0.189) + 0.192\right]$

$y(0.2) = 0.488$

$\therefore$ The required solution of $y(0.2) = 0.488$.

(7) Using lagrange's Interpolation method estimate y at $x = 1.4$ for the following data

x	1	2	4	7
y	0	3	12	7

Sol Given

x	1	2	4	7
y	0	3	12	7

y at $x = 1.4$

let $x_0 = 1$; $x_1 = 2$; $x_2 = 4$; $x_3 = 7$
$y_0 = 0$; $y_1 = 3$; $y_2 = 12$; $y_3 = 7$ } at $x = 1.4$

$$y = f(x) = \frac{(x-x_1)(x-x_2)(x-x_3)}{(x_0-x_1)(x_0-x_2)(x_0-x_3)} y_0 + \frac{(x-x_0)(x-x_2)(x-x_3)}{(x_1-x_0)(x_1-x_2)(x_1-x_3)} y_1$$

$$+ \frac{(x-x_0)(x-x_1)(x-x_3)}{(x_2-x_0)(x_2-x_1)(x_2-x_3)} y_2 + \frac{(x-x_0)(x-x_1)(x-x_2)}{(x_3-x_0)(x_3-x_1)(x_3-x_2)} y_3$$

$$y = f(1.4) = \frac{(1.4-2)(1.4-4)(1.4-7)}{(1-2)(1-4)(1-7)} (0) + \frac{(1.4-1)(1.4-4)(1.4-7)}{(2-1)(2-4)(2-7)}$$

$$+\frac{(1.4-1)(1.4-2)(1.4-7)}{(4-1)(4-2)(4-7)}(12)+\frac{(1.4-1)(1.4-2)(1.4-4)}{(7-1)(7-2)(7-4)}(7)$$

$$= 0 + 1.747 + (-0.896) + 0.049$$

$$= 0.900$$

∴ The required y value at $x = 1.4$ is 0.900.

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Submission Records:

S. No	ROLL NUMBER	STUDENT NAME
1	20221BSE0001	R K S H Kashyap
2	20221BSE0002	Paraj Yaman
3	20221BSE0003	Renaissa Das
4	20221BSE0004	Pashikanti Srimayee
5	20221BSE0005	Sambana Hemavati
6	20221BSE0007	Katikitala Vincent Yadeedya

Total Number of Eligible Students : 6

Total Number of Students Submitted : 6

Signature of Instructor In-Charge :

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