

DEPARTMENT OF MATHEMATICS
"T3 Examination, June-2022"

SEMESTER	IInd	DATE OF EXAM	23-06-2022
SUBJECT NAME	Discrete Mathematics	SUBJECT CODE	MAH104B-T
BRANCH	CSE / AIML	SESSION	Ist
TIME	8:30 AM-11:30 AM	MAX. MARKS	100
PROGRAM	B.Tech.	CREDITS	4
NAME OF FACULTY	Dr. Ankita Gaur, Dr. Dinesh Tripathi, Dr. Advin Masih, Mr. Ramapati Maurya Dr. Bhawna Singla	NAME OF COURSE COORDINATOR	Dr. Ankita Gaur <i>y K Sharmas</i>

Note: All questions are compulsory.

PART-A	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
	Q.1.	<p>Draw the Hasse diagram of D_{42}. Determine the least and greatest element if exist.</p> <p>(a) Determine the l.u.b. and g.l.b of all pairs of elements. (b) Find 4 sublattices with four or more elements.</p>	10	CO1	L3
	Q.2	<p>Given the following statements as premises, all referring to an arbitrary meal:</p> <p>(a) If he takes coffee, he doesn't drink milk. (b) He eats crackers only if he drinks milk. (c) He does not take soup unless he eats crackers. (d) At noon today, he had coffee.</p> <p>Whether he took soup at noon today? If so, what is the correct conclusion? Also show that $\neg(P \rightarrow Q)$ and $P \wedge \neg Q$ logically equivalent.</p>	10	CO2	L4
	Q.3	<p>In any Boolean algebra, prove that $b = c$ if and only if both $a + b = a + c$ and $ab = ac$ holds.</p>	10	CO3	L4
	Q.4	<p>Define Boolean algebra. Show that the Boolean expression $Y = (P + Q)(P + Q')(P' + Q)$ can be simplified as $Y = PQ$.</p>	10	CO3	L4

PART-B

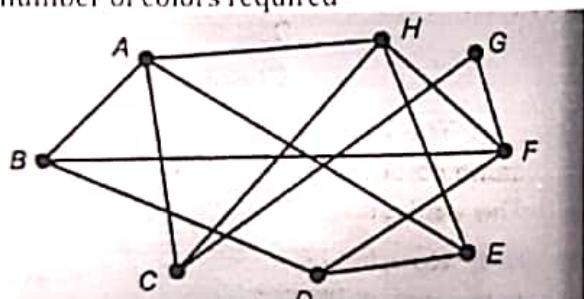
Q.5	<p>Minimize the four variable K – map $f(A, B, C, D) = \sum m(0,1,2,3,5,7,8,9,11,14)$</p>	10	CO3	L3
Q.6	<p>Define abelian group. Show that the set {1,2,3,4,5} is not a group under addition and multiplication modulo 6.</p>	10	CO3	L4
Q.7	<p>Apply Dijkstra's algorithm to determine the shortest path between a to z in in the graph given below:</p>	10	CO4	L3
Q.8	<p>Describe Prim's and Kruskal's algorithms and using both algorithms find out the minimal spanning tree of the following graph</p>	10	CO4	L3
Q.9	<p>What do you mean by a planar graph and regions of a planar graph? Explain with an example. Write the Euler's formula and using it show that if every region of a simple planer graph with n vertices and e edges is bounded by k edges, then $e = \frac{k(n-2)}{(k-2)}$.</p>	10	CO4	L3

PART-C

Q.10

Explain the terms proper coloring and chromatic number and hence find chromatic number of $K_{m,n}$.

Using Welch Powell algorithm to determine the number of colors required for coloring the following graph. Also, find the minimum number of colors required



10

C04

L3

DEPARTMENT OF MATHEMATICS
 "T3 Examination, June-2022"

SEMESTER	II	DATE OF EXAM	23/06/2022
SUBJECT NAME	CALCULUS AND LINEAR ALGEBRA	SUBJECT CODE	MAH101-B
BRANCH	B.Tech. CSE -CDA/CSTI	SESSION	I
TIME	8:30-11:30am	MAX. MARKS	100
PROGRAM	B.Tech.(CSE)	CREDITS	4
NAME OF FACULTY	Dr. Ruchi Gupta & Dr. Ankita Gaur	NAME OF COURSE COORDINATOR	Dr. Ruchi Gupta <i>qulsham</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARK S	CO ADDRESSED	BLOOM' S LEVEL	PI
PART-A	Q1	If $u = f(r)$ and $x = r \cos \theta$, $y = r \sin \theta$, prove that $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = f''(r) + \frac{1}{r} f'(r)$.	10	CO1	BT3	1.1. 1
PART-B	Q2	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dz dy dx}{\sqrt{1-x^2-y^2-z^2}}$, by changing to spherical polar co-ordinates.	10	CO2	BT4	1.1. 1
PART-C	Q3(A)	Find non-singular matrices P and Q such that PAQ is in normal form, where, $\begin{bmatrix} 3 & 1 & 2 & 1 \\ 1 & 4 & 6 & 1 \\ 2 & -3 & 1 & -2 \end{bmatrix}$	10	CO3	BT4	1.1. 1
	(B)	Find the inverse of $A = \begin{bmatrix} 8 & 4 & 3 \\ 2 & 1 & 1 \\ 1 & 2 & 1 \end{bmatrix}$ by elementary row operations.	10	CO3	BT3	1.1. 1
	Q4(A)	For what value of λ , the equations $\begin{aligned} x + y + z &= 1 \\ x + 2y + 4z &= \lambda \\ x + 4y + 10z &= \lambda^2 \end{aligned}$ have solutions and solve them completely in each case.	10	CO3	BT4	1.1. 1
	(B)	Show that the transformation $\begin{aligned} y_1 &= x_1 - x_2 + x_3, \\ y_2 &= 3x_1 - x_2 + 2x_3, \\ y_3 &= 2x_1 - 2x_2 + 3x_3 \end{aligned}$ is regular. Find the inverse transformation.	10	CO3	BT3	1.1. 1

Q5	Diagonalise the matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ and hence find A^4 .	20	CO4	BT3	1.1. 1
Q6(A)	Verify Cayley - Hamilton theorem for the matrix A and compute A^{-1} where $A = \begin{bmatrix} 0 & 0 & 1 \\ 3 & 1 & 0 \\ -2 & 1 & 4 \end{bmatrix}$.	10	CO4	BT3	1.1. 1
(B)	Determine the characteristic roots and corresponding characteristic vectors of the matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$.	10	CO4	BT3	1.1. 1

***** END *****

DEPARTMENT OF MATHEMATICS

"T3 Examination, June-2022"

SEMESTER	II	DATE OF EXAM	23/06/2022
SUBJECT NAME	MATHEMATICS II	SUBJECT CODE	MAH105B-T
BRANCH	Mechanical	SESSION	I
TIME	3 hrs	MAX. MARKS	100
PROGRAM	B.Tech.(Mechanical)	CREDITS	4
NAME OF FACULTY	Ms. Seema Aggarwal	NAME OF COURSE COORDINATOR	Ms. Seema Aggarwal <i>YK Shrivastava</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM' S LEVEL	PI
PART-A	Q1(a)	Prove that $\int_1^2 \int_3^4 (xy + e^y) dy dx = \int_3^4 \int_1^2 (xy + e^y) dx dy$.	5	CO1	BT2	1,2
	Q1(b)	Prove that $\int_0^\infty x^{p-1} e^{-kx} dx = \frac{1}{k^p} \Gamma(p)$, ($k > 0$),	5	CO1	BT2	1,2
PART-B	Q2(a)	If the temperature of the air is $30^\circ C$ and the substance cools from $100^\circ C$ to $70^\circ C$ in 15 minutes, find when the temperature will be $40^\circ C$.	10	CO2	BT3	1,2
	Q3(a)	Find the values of A and B such that the function $f(z) = x^2 + Ay^2 - 2xy + i(Bx^2 - y^2 + 2xy)$ is analytic. Also find $f'(z)$.	5	CO3	BT3	1,2
PART-C	Q3(b)	Show that the function $u = e^{-2xy} \sin(x^2 - y^2)$ is harmonic. Find the conjugate function v and express $u + iv$ as an analytic function of z .	15	CO3	BT3	1,2
	Q4(a)	Show that the transformation $w = \frac{2z+3}{z-4}$ maps the circle $x^2 + y^2 - 4x = 0$ onto the straight line $4u + 3 = 0$	10	CO3	BT3	1,2
PART-D	Q4(b)	Find the bilinear transformation which maps the points $z = 1, i, -1$ into the points $w = i, 0, -i$. Hence, find the image of $ z < 1$.	10	CO3	BT3	
	Q5(a)	Show that $\oint_C (z+1) dz = 0$, where C is the boundary of the square whose vertices are at the points $z = 0, z = 1, z = 1+i$ and $z = i$.	10	CO3	BT3	
	Q5(b)	Evaluate $\oint_C \frac{e^z}{(z-1)(z-2)^2} dz$, where C is the circle $ z = 3$ using Cauchy's Integral Theorem/Formula.	10	CO3	BT3	

	<p>Find the series expansion of $f(z) = \frac{z^2 - 1}{z^2 + 5z + 6}$ about $z = 0$ in the region (i) $z < 2$ (ii) $2 < z < 3$.</p> <p>Q6(a) Identify the series.</p>	10	CO3	BT3	
Q6(b)	<p>Evaluate $\oint_C \frac{z-3}{(z)^2+2z+5} dz$, where C is the circle given by (i) $z + 1 - i = 2$ (ii) $z + 1 + i = 2$ using Residue Theorem.</p>	10	CO3	BT3	

END

DEPARTMENT OF MATHEMATICS

"T3 Examination, June-2022"

SEMESTER	SECOND	DATE OF EXAM	23/06/2022
SUBJECT NAME	STATISTICS - II	SUBJECT CODE	MAH205B
BRANCH	MATHEMATICS	SESSION	MORNING
TIME	3 Hrs	MAX. MARKS	100
PROGRAM	B.Sc. (II)	CREDITS	4
NAME OF FACULTY	Ms. Savitta Saini	NAME OF COURSE COORDINATOR	Ms. Savitta Saini <i>YK Sharma</i>

Note: All questions are compulsory.

Q.NO.	QUESTIONS	M	CO	BLO	PI																				
		AR	AD	OM'																					
1(A)	A random variable X has the following probability distribution: <table border="1"> <tr> <td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr> <td>p(x)</td><td>a</td><td>3a</td><td>5a</td><td>7a</td><td>9a</td><td>11a</td><td>13a</td><td>15a</td><td>17a</td></tr> </table>	x	0	1	2	3	4	5	6	7	8	p(x)	a	3a	5a	7a	9a	11a	13a	15a	17a	5	CO1	BT3	1.1.1 2.1.1 3.2.2 4.1.2
x	0	1	2	3	4	5	6	7	8																
p(x)	a	3a	5a	7a	9a	11a	13a	15a	17a																
	(i) Determine the value of a. (ii) What is the smallest value of x for which $P(X \leq x) > 0.5$?																								
1(B)	The incidence of occupational disease in an industry is such that the workers have a 20% chance of suffering from it. What is the probability that out of six workers chosen at random, four or more will suffer from the disease?	5	CO1	BT3	1.1.1 2.1.1 3.2.2 4.1.2																				
2(A)	In a certain factory turning razor blades, there is a small chance of 0.002 for any blade to be defective. The blades are supplied in	5	CO2	BT3	1.1.1 2.1.1 3.2.2 4.1.2																				

packets of 10. Use Poisson distribution to calculate the approximate number of packets containing no defective, one defective and two defective blades respectively in a consignment of 10000 packets.

2(B)

The life of an electronic tube of a certain type may be assumed to be normally distributed with mean 155 hours and standard deviation 19 hours. What is the probability that

- (i) the life of randomly chosen tube is between 136 hours and 174 hours
- (ii) the life of a randomly chosen tube will be more than 395 hours.

5

CO2

BT3

1.1.1
2.1.1
3.2.2
4.1.2

3(A)

A sales clerk in the departmental store claims that 60% of the shoppers entering the store leave without making a purchase. A random sample of 50 shoppers showed that 35 of them left without buying anything. Are these sample results consistent with the claim of the sales clerk? Use a level of significance of 0.05.

10

CO3

BT4

1.1.1
2.1.1
3.2.2
4.3.4
13.1.1

3(B)

An ambulance service claims that it takes, on the average, 8.9 minutes to reach its destination in emergency calls. To check this claim, the agency which licenses ambulance services has then timed on 50 emergency calls, getting a mean of 9.3 minutes with a standard deviation of 1.8 minutes. At the level of significance of 0.05, does this constitute evidence that the figure claimed is too low?

10

CO3

BT4

1.1.1
2.1.1
3.2.2
4.3.4
5.1.1
7.1.1
8.2.1
10.3.3
11.2.2
13.1.1

4(A)

A product is produced in two ways. A pilot test on 64 times from each method indicates that the product of Method I has a sample mean tensile strength 106 lbs and a standard deviation 12 lbs, whereas in Method II the corresponding value of mean and standard deviation are 100 lbs and 10 lbs respectively. Greater tensile strength in the product is preferable. Use an appropriate large sample test of 5% level of significance to test whether or not Method I is better for processing the product. State clearly the null hypothesis.

10

CO3

BT4

1.1.1
2.1.1
3.2.2
4.3.4
5.1.1
7.1.1
8.2.1
10.3.3
13.1.1

4(B)

The mean yield of two sets of plots and their variability are as given.

- (a) Examine whether the difference in the mean yield of two sets of plots is significant.

10

CO3

BT4

1.1.1
2.1.1
5.1.1
11.2.2
13.1.1

(b) Examine whether the difference in the variability in yields is significant.

	Set of 40 plots	Set of 60 plots
Mean yield per plot	1258 lbs.	1243 lbs.
S.D. per plot	34	28

A survey of 320 families with 5 children each revealed the following information:

No. of boys	5	4	3	2	1	0
No. of girls	0	1	2	3	4	5
No. of families	14	56	110	88	40	12

5(A)

1.1.1
2.1.1
3.2.2
4.3.4
5.1.1
7.1.1
8.2.1
10.3.3
11.2.2
13.1.1

Is the result consistent with the hypothesis that male and female birth are equally probable?

5(B)

The height of 6 randomly chosen sailors in inches are 63, 65, 68, 69, 71 and 72. Those of 9 randomly chosen soldiers are 61, 62, 65, 66, 69, 70, 71, 72 and 73. Test whether the sailors are on the average taller than soldiers.

1.1.1
2.1.1
3.2.2
4.3.4
5.1.1
7.1.1
8.2.1

6(A)

Sampl	20	16	26	27	23	22	18	24	25	19	
A											
Sampl	27	33	42	35	32	34	38	28	41	43	30
B											

1.1.1
2.1.1
3.2.2
4.3.4
5.1.1
7.1.1
8.2.1
10.3.3

Obtain estimates of the variances of the population and test whether two populations have the same variance.

Ten workers were given a training programme with a view to shorten their assembly time for a certain mechanism. The results of the time and motion studies before and after the training programme are given below:

Worker	1	2	3	4	5	6	7	8	9	10
First Study (in minutes)	15	18	20	17	16	14	21	19	13	22
Second Study (in minutes)	14	16	21	10	15	18	19	16	14	20

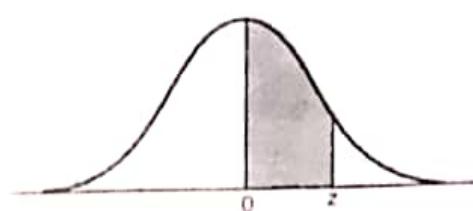
On the basis of this data , can it be concluded that the training program has shortened the average assembly time?

END

10 CO4 BT4
1.1.1
2.1.1
3.2.2
4.3.4
5.1.1
7.1.1
8.2.1
10.3.3
11.2.2
13.1.1

APPENDIX

VII. AREA UNDER STANDARD NORMAL CURVE



	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.0000	0.0100	0.0200	0.0200	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0348	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1231	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1679	0.1619	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.2125	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2571	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.3017	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.3463	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3909	0.3485	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.4355	0.3438	0.3464	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.4801	0.3663	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.5247	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015	
1.3	0.5692	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.6137	0.4207	0.4222	0.4236	0.4251	0.4266	0.4279	0.4292	0.4306	0.4319
1.5	0.6582	0.4343	0.4367	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.7027	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.7472	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.7917	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.8362	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.8807	0.4776	0.4789	0.4798	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.9252	0.4776	0.4789	0.4798	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.2	0.9697	0.4836	0.4836	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.3	1.0141	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.4	1.0585	0.4900	0.4908	0.4904	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.5	1.0929	0.4927	0.4929	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936	
2.6	1.1373	0.4940	0.4944	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.7	1.1817	0.4946	0.4946	0.4947	0.4949	0.4950	0.4954	0.4964	0.4962	0.4963
2.8	1.2261	0.4953	0.4953	0.4954	0.4954	0.4950	0.4970	0.4974	0.4972	0.4973
2.9	1.2705	0.4966	0.4967	0.4968	0.4968	0.4969	0.4978	0.4979	0.4980	0.4981
3.0	1.3149	0.4974	0.4976	0.4977	0.4977	0.4978	0.4979	0.4980	0.4980	0.4986
3.1	1.3593	0.4982	0.4982	0.4984	0.4984	0.4984	0.4985	0.4985	0.4986	0.4990
3.2	1.4037	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

**Table 3: CHI-SQUARE (χ^2)
Significant Values $\chi^2(\alpha)$ of χ^2 Distribution Right Tail Areas
for Given Probability α ,
 $P = P_r(\chi^2 > \chi^2(\alpha)) = \alpha$
And is Degrees of Freedom (d.f.)**

Degrees of freedom (v)	Probability (Level of Significance)						
	0.99	0.95	0.50	0.10	0.05	0.02	0.01
1	0.000157	0.00393	0.455	2.706	3.841	5.214	6.635
2	0.0201	0.103	1.386	4.605	5.991	7.824	9.210
3	0.115	0.352	2.366	6.251	7.815	9.837	11.341
4	0.297	0.711	3.357	7.779	9.488	11.668	13.277
5	0.554	1.145	4.351	9.236	11.070	13.388	15.086
6	0.872	2.035	5.348	10.645	12.592	15.033	16.812
7	1.239	2.467	6.346	12.017	14.067	16.622	18.475
8	1.646	2.733	7.344	13.362	15.507	18.168	20.090
9	2.088	3.325	8.343	14.684	16.919	19.679	21.669
10	2.558	3.940	9.340	15.987	18.307	21.161	23.209
11	3.053	4.575	10.341	17.275	19.675	22.618	24.725
12	3.571	5.226	11.340	18.549	21.026	24.054	26.217
13	4.107	5.892	12.340	19.812	22.362	25.472	27.688
14	4.660	6.571	13.339	21.064	23.685	26.873	29.141
15	5.229	7.261	14.339	22.307	24.996	28.259	30.578
16	5.812	7.962	15.338	23.542	26.296	29.633	32.000
17	6.408	8.672	15.338	24.769	27.587	30.995	33.409
18	7.015	9.390	17.338	25.989	28.869	32.346	34.805
19	7.633	10.117	18.338	27.204	30.144	33.687	36.191
20	8.260	10.851	19.337	28.412	31.410	35.020	37.566
21	8.897	11.594	20.337	29.615	32.671	36.343	38.932
22	9.542	12.338	21.337	30.813	33.924	37.659	40.289
23	10.196	13.091	22.337	32.007	35.172	38.968	41.638
24	10.856	13.848	23.337	32.196	36.415	40.270	42.980
25	11.524	14.611	24.337	34.382	37.65	41.566	44.314
26	12.198	15.379	25.336	35.363	38.885	41.856	45.642
27	12.879	16.151	26.336	36.741	40.113	41.140	46.963
28	13.565	16.928	27.336	37.916	41.337	45.419	48.278
29	14.256	17.708	28.336	39.087	42.557	46.693	49.588
30	14.953	18.493	29.336	40.256	43.773	47.962	50.892

Note. For degrees of freedom (v) greater than 30, the quantity $\sqrt{2\chi^2} - \sqrt{2v-1}$ may be used as a normal variate with unit variance.



N. 5% POINTS OF FISHER'S F-DISTRIBUTION

$n \backslash m$	1	2	3	4	5	6	7	8	9	10	12	15	20	30	60	a
1	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.95	248.01	250.69	252.20	254.32
2	18.513	19.000	19.164	19.247	19.296	19.350	19.353	19.371	19.385	19.396	19.413	19.420	19.446	19.462	19.479	19.496
3	10.128	9.5521	9.2766	9.1172	9.0135	8.9406	8.8868	8.8152	8.7855	8.7446	8.7029	8.6602	8.6166	8.5720	8.5265	
4	7.7086	6.9443	6.5914	6.3883	6.2560	6.1631	6.0942	6.0110	5.9988	5.9644	5.9117	5.8578	5.8025	5.7459	5.6878	5.0281
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8753	4.8183	4.7725	4.7351	4.6777	4.6188	4.5581	4.4957	4.4314	4.3650
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2066	4.1468	4.0990	4.0600	3.9999	3.9381	3.8742	3.8182	3.7398	3.6688
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.8660	3.7870	3.7257	3.6767	3.6365	3.5747	3.5108	3.4445	3.3758	3.3043	3.2298
8	5.3177	4.4590	4.0662	3.8378	3.6875	3.5806	3.5005	3.4581	3.3881	3.3472	3.2840	3.2184	3.1503	3.0794	3.0953	2.9276
9	5.1174	4.2565	3.8626	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789	3.1373	3.0729	3.0001	2.9365	2.8657	2.7872	2.7007
10	4.9646	4.1028	3.7083	3.4780	3.3258	3.2172	3.1355	3.0717	3.0204	2.9782	2.9130	2.8450	2.7740	2.6996	2.6211	2.5379
11	4.8443	3.9823	3.5874	3.3567	3.2059	3.0946	3.0123	2.9480	2.8962	2.8536	2.7876	2.7186	2.6464	2.5705	2.4901	2.4045
12	4.7272	3.8853	3.4903	3.2502	3.1059	2.9961	2.9131	2.8486	2.7964	2.7554	2.6866	2.6169	2.5436	2.4663	2.3842	2.2962
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8521	2.7669	2.7141	2.6710	2.6037	2.5351	2.4589	2.3803	2.2966	2.2064
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458	2.6021	2.5342	2.4650	2.3879	2.3082	2.2230	2.1307
15	4.5451	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876	2.5437	2.4753	2.4055	2.3275	2.2468	2.1601	2.0658
16	4.4940	3.6337	3.2389	3.0069	2.88524	2.7413	2.6572	2.5911	2.5377	2.4935	2.4247	2.3522	2.2756	2.1958	2.1058	2.0096
17	4.4513	3.5915	3.1968	2.9647	2.8100	2.6987	2.6145	2.5480	2.4943	2.4499	2.3807	2.3077	2.2304	2.1477	2.0584	1.9604
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563	2.4117	2.3421	2.2686	2.1906	2.1071	2.0166	1.9168
19	4.3808	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227	2.3779	2.3080	2.2341	2.1555	2.0712	1.9796	1.8780
20	4.3513	3.4928	3.0984	2.8661	2.7100	2.5990	2.5140	2.4471	2.3928	2.3479	2.2776	2.2053	2.1242	2.0391	1.9464	1.8432
21	4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.3661	2.3210	2.2504	2.1787	2.0960	2.0102	1.9165	1.8117
22	4.3009	3.4454	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419	2.2967	2.2258	2.1508	2.0707	1.9842	1.8895	1.7851
23	4.2793	3.4221	3.0280	2.7955	2.6500	2.5377	2.4422	2.3748	2.3201	2.2747	2.2036	2.1282	2.0476	1.9505	1.8649	1.7570
24	4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002	2.2547	2.1834	2.1077	2.0267	1.9390	1.8424	1.7331
25	4.2417	3.3852	2.9912	2.7587	2.6030	2.4904	2.4047	2.3371	2.2821	2.2365	2.1649	2.0889	2.0075	1.9192	1.8217	1.7110
26	4.2252	3.3690	2.9751	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655	2.2197	2.1479	2.0716	1.9898	1.9010	1.8027	1.6906
27	4.2100	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501	2.2043	2.1323	2.0558	1.9736	1.8842	1.7851	1.6717
28	4.1901	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.2360	2.1900	2.1179	2.0411	1.9586	1.8687	1.7689	1.6511
29	4.1704	3.3277	2.9240	2.7014	2.5454	2.4324	2.3463	2.2782	2.2229	2.1768	2.1045	2.0275	1.9446	1.8545	1.7557	1.6377
30	4.1502	3.3158	2.9223	2.6896	2.5376	2.4205	2.3313	2.2662	2.2107	2.1646	2.0921	2.0148	1.9317	1.8409	1.7496	1.6223
31	4.1303	3.3047	2.8987	2.6669	2.4915	2.3559	2.2490	1.802	2.1240	2.0772	2.0045	1.9245	1.8389	1.7444	1.6473	1.5089
32	4.1043	3.2944	2.7581	2.5251	2.3988	2.2840	2.1665	1.9791	2.0401	1.9926	1.9144	1.8364	1.7480	1.6491	1.5313	1.4893
33	4.0713	3.2845	2.6802	2.4969	2.3159	2.0867	1.9164	1.8588	1.9105	1.8333	1.7505	1.6583	1.5543	1.4200	1.2559	
34	4.0413	3.2744	2.6649	2.4044	2.1759	2.0096	1.9184	1.8307	1.7605	1.6801	1.5891	1.4893	1.3806	1.2800	1.0600	

Table 2 : SIGNIFICANT VALUES $t_{\nu}(\alpha)$ OF t-DISTRIBUTION
 (TWO TAIL AREAS) $[\mid t \mid > t_{\nu}(\alpha)] = \alpha$

ν	Probability (Level of Significance)					
	0.50	0.10	0.05	0.02	0.01	0.001
1	1.00	6.31	12.71	31.82	63.66	636.62
2	0.82	0.92	4.30	6.97	6.93	31.60
3	0.77	2.32	3.18	4.54	5.84	12.94
4	0.74	2.13	2.78	3.75	4.60	8.61
5	0.73	2.02	2.57	3.37	4.03	6.86
6	0.72	1.94	2.45	3.14	3.71	5.96
7	0.71	1.90	2.37	3.00	3.50	5.41
8	0.71	1.80	2.31	2.90	3.36	5.04
9	0.70	1.83	2.26	2.82	3.25	4.78
10	0.70	1.81	2.23	2.76	3.17	4.59
11	0.70	1.80	2.20	2.72	3.11	4.44
12	0.70	1.78	2.18	2.68	3.06	4.32
13	0.69	1.77	2.16	2.65	3.01	4.22
14	0.69	1.76	2.15	2.62	2.98	4.14
15	0.69	1.75	2.13	2.60	2.95	4.07
16	0.69	1.75	2.12	2.58	2.92	4.02
17	0.69	1.74	2.11	2.57	2.90	3.97
18	0.69	1.73	2.10	2.55	2.88	3.92
19	0.69	1.73	2.09	2.54	2.86	3.88
20	0.69	1.73	2.09	2.53	2.85	3.85
21	0.69	1.72	2.08	2.52	2.83	3.83
22	0.69	1.72	2.07	2.51	2.82	3.79
23	0.69	1.71	2.07	2.50	2.81	3.77
24	0.69	1.71	2.06	2.49	2.80	3.75
25	0.68	1.71	2.06	2.49	2.79	3.73
26	0.68	1.71	2.06	2.48	2.78	3.71
27	0.68	1.70	2.05	2.47	2.77	3.69
28	0.68	1.70	2.05	2.47	2.76	3.67
29	0.68	1.70	2.05	2.46	2.76	3.66
30	0.68	1.70	2.04	2.46	2.75	3.65
32	0.67	1.65	1.96	2.33	2.58	3.29

DEPARTMENT OF MATHEMATICS
"T3 Examination, June-2022"

SEMESTER	Second	DATE OF EXAM	27/06/2022
SUBJECT NAME	Calculus II	SUBJECT CODE	MAH115B
BRANCH	MATHEMATICS	SESSION	Morning
TIME	08:30 AM-11:30AM	MAX. MARKS	100
PROGRAM	B.Sc.	CREDITS	4
NAME OF FACULTY	Dr Kalpana Shukla	NAME OF COURSE COORDINATOR	Dr Kalpana Shukla <i>YK Shukla</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MAR KS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Evaluate the following using reduction formula $\int_0^{\pi/2} \sin^6 x \cos^2 x dx$	5	C01	BT1	[1.1.2]
	1(B)	Find the entire length of the Find the arc length of $x = t^2, y = t - \frac{1}{3}t^3$	5	C01	BT2	[1.1.2]
PART-B	Q2 (A)	Find the area lying between the parabola $4x = y^2$ and the line $4y = x^2$.	5	C02	BT3	[1.1.1] 1
	Q2 (B)	Show that $B(m, n) = B(m + 1, n) + B(m, n + 1)$.	5	C02	BT3	[1.1.1] 1
PART-C	Q3	Show that (i) $\nabla \log r = \frac{\vec{r}}{r^2}$. (ii) $\text{grad} \left(\frac{1}{r^2} \right) = -\frac{2\vec{r}}{r^4}$	10	C03	BT2	[2.3.1] 1
	Q4	Find a unit vector normal to the surface $xy^3z^2 = 4$ at the point $(-1, -1, 2)$	10	C03	BT4	[4.1.1] 1
	Q5	The temperature at a point (x, y, z) in space is given by $T(x, y, z) = 2x^2 + 2y^2 - z$. A mosquito located at $(4, 1, 2)$ desires to fly in such a direction	10	C03	BT3	[4.1.1] 1

		that it will get warm as soon as possible. In what direction should it fly?				
	Q6	Check that $(x + 3y)\hat{i} + (y - 3z)\hat{j} + (x - 2z)\hat{k}$ is both solenoidal and irrotational?	10			
	Q7	If $\vec{F} = y^2dx - x^2dy$, evaluate $\int_C \vec{F} \cdot d\vec{r}$ along the curve C is the triangle whose vertices are (1,0),(0,1) and (-1,0).	10	C04	BT2	[3.1.2]
PART-D	Q8	Check the Gauss divergence theorem for $\vec{F} = 2x\hat{i} - x\hat{j} + z^2\hat{k}$ taken over the region bounded by the cylinder $x^2 + y^2 = 4, z = 0, z = 5$.	10	C04	BT3	[4.1.1]
	Q9	State the Green's theorem. And find $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the boundary of the region defined by $x=0, y=0, x+y=1$. by using green theorem.	10	C04	BT3	[1.1.2]
	Q10	Evaluate $\int_C \vec{F} \cdot d\vec{r}$ by Stoke's Theorem, where $\vec{F} = (x^2 - y^2)\hat{i} + 2xy\hat{j}$ and C is the boundary of the lines $x=0, y=0, x=a, y=b$.	10	C04	BT3	[1.1.1]
		***** END *****				



**MANAV RACHNA
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DEPARTMENT OF MATHEMATICS

"T3 Examination, July-2022"

SEMESTER	II	DATE OF EXAM	01/07/2022
SUBJECT NAME	ORDINARY DIFFERENTIAL EQUATIONS	SUBJECT CODE	MAH112B
BRANCH	BSc(H) Maths	SESSION	I
TIME	08: 30-11:30PM	MAX. MARKS	100
PROGRAM	BSc(H) Maths	CREDITS	4
NAME OF FACULTY	Dr.Bhawna Singla	NAME OF COURSE COORDINATOR	Dr.Bhawna Singla <i>y k sharma</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL
PART-A	Q1(a)	Show that the family of curves $y^2 = 4a(x + a)$ is self orthogonal.	5	CO1	BT3
	Q1(b)	Solve $(D-1)^2y = \sin x$	5	CO2	BT3
PART-B	Q2(a)	Solve the equation: $(x^2 + y^2 + 1)dx - 2xydy = 0$	5	CO1	BT3
	Q2(b)	$\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x \cos x$	5	CO2	BT3
PART-C	Q3(A)	Solve the equation: $x^2 \frac{d^2u}{dx^2} + x \frac{du}{dx} - u + kx^3 = 0$, where k is a constant. Solve the equation under the conditions $u=0$ when $x=0$, $u=0$ when $x=a$.	10	CO3	BT4
	TRY	Solve $\frac{d^2y}{dx^2} + (1 - \cot x)\frac{dy}{dx} - y \cot x = \sin^2 x$	10	CO3	BT4

PART-D

	Solve by the method of variation of parameters: $\frac{d^2y}{dx^2} + a^2 y = \operatorname{cosec} ax$	10	CO3	BT3
B	Solve the following simultaneous differential equations : $3 \frac{dx}{dt} + 5x - 2y = t$, $\frac{dy}{dt} + 2x + y = 0$ Given that $x=0, y=0$ when $t=0$.	10	CO3	BT3
Q5(A)	A tank contains 40L of solution containing 2g of substance per litre. Salt water containing 3g of this substance per litre runs in at the rate of 4 L/min & well stirred mixture runs out at same rate. Develop a model & find the amount of substance in tank after 15 minutes.	10	CO4	BT4
(B)	What do you mean by Mathematical Modeling? Explain model of drug assimilation into blood of a single cold pill.	10	CO4	BT3
Q6(A)	Develop an IVP for radioactivity with Exponential decay and solve it with initial condition $N(t_0) = N_0$.	10	CO4	BT4
(B)	Calculate the doubling time for population of insects which increases by 15% every year.	10	CO4	BT4

DEPARTMENT OF MATHEMATICS
"T3 Examination, June 2022"

SEMESTER	II	DATE OF EXAM	04.07.2022
SUBJECT NAME	ALGEBRA	SUBJECT CODE	MAH107B
BRANCH	B.Sc.(H) Mathematics	SESSION	Ist
TIME	8:30am – 11:30 am	MAX. MARKS	100
PROGRAM	B.Sc.(H) Mathematics	CREDITS	4
NAME OF FACULTY	Dr. Deepa Arora	NAME OF COURSE COORDINATOR	Dr. Deepa Arora <i>y K Shaujan</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MAR KS	CO ADD RES SED	BLOO M'S LEVE L	P.I.
PART-A&B	Q.1.	Find the gcd and lcm of 119 and 272. Also express gcd as a linear combination of 119 and 272.	10	CO1	BT3	1.1.1 2.1.2 3.1.2
	Q.2	(i) What is the remainder when the sum $1^5 + 2^5 + 3^5 + \dots + 100^5$ is divided by 4? (ii) Solve the linear congruence $6x \equiv 15 \pmod{21}$.	5+5	CO2	BT3	1.1.1 2.1.2 3.1.2
	Q.3	(i) Given that -4 is a root of the equation $2x^3 + 6x^2 + 7x + 60 = 0$. Find the other roots. (ii) Solve the equation $x^4 + 2x^3 - 16x^2 - 22x + 7 = 0$ completely, given that one root is $2 + \sqrt{3}$.	7+7	CO3	BT3	1.1.1 2.1.2 3.1.2
	Q.4	Form an equation whose roots shall be the squares of the roots of the equation $x^3 + 3x^2 + 6x + 1 = 0$.	6	CO3	BT4	1.1.1 2.1.2 3.1.2
	Q.5	Solve by Cardan's method, the equation $x^3 + 6x^2 + 9x + 4 = 0$	10	CO3	BT3	1.1.1 2.1.2 3.1.2

Q.6	Solve the equation $x^4 - 10x^3 + 35x^2 - 50x + 24 = 0$ by Ferrari's method.	10	CO3	BT3	1.1.1 2.1.2 3.1.2
	(i) By using elementary transformations, find the inverse of the matrix	5	CO4	BT-3	1.1.1 2.1.2 3.1.2
	$A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$				
	For the matrix $A = \begin{bmatrix} 1 & 2 & 3 & -2 \\ 2 & -2 & 1 & 3 \\ 3 & 0 & 4 & 1 \end{bmatrix}$ find non - singular matrices P & Q such that PAQ is in the normal form. Hence find the rank of A.	10	CO4	BT-3	1.1.1 2.1.2 3.1.2
	Find the Eigen values and corresponding Eigen vectors of the matrix	10	CO4	BT-3	1.1.1 2.1.2 3.1.2
	$A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$				
	Also find the eigen values of A^3 .				
	(i) If $A = \begin{bmatrix} 1 & 2 \\ -1 & 3 \end{bmatrix}$, express $A^6 - 4A^5 + 8A^4 - 12A^3 + 14A^2$ as a linear polynomial in A.	5	CO4	BT3	1.1.1 2.1.2 3.1.2
	(ii) Represent each of the transformation $x_1 = 3y_1 + 2y_2, x_2 = -y_1 + 4y_2, y_1 = z_1 + 2z_2, y_2 = 3z_1$ by the use of matrices and find the composite transformation which expresses x_1, x_2 in terms of z_1, z_2 . Is this composite transformation orthogonal? Give reason.	5	CO4	BT3	1.1.1 2.1.2 3.1.2
	(iii) For what values of a and b do the equations $x + y + z = 6, x + 2y + 3z = 10, x + 2y + az = b$ have (i) no solution (ii) a unique solution (iii) more than one solution?	5	CO4	BT4	1.1.1 2.1.2 3.1.2

DEPARTMENT OF MATHEMATICS
"T3 Examination, May-2022"

SEMESTER	IV	DATE OF EXAM	23-05-2022
SUBJECT NAME	ADVANCED ANALYSIS	SUBJECT CODE	MAH210B
BRANCH	Mathematics	SESSION	I
TIME	3.00 Hrs.	MAX. MARKS	100
PROGRAM	B.Sc.(H) Mathematics	CREDITS	4
NAME OF FACULTY	Dr. Aparna Vyas	NAME OF COURSE COORDINATOR	Dr. Aparna Vyas <i>YK Sharma</i>

Note: Part A, B, C, D: All questions are compulsory.

Q.NO.	QUESTIONS	MAR KS	CO ADDRESSED	BLOO M'S LEVE L	PI
PART-A PART-B	1 State and prove generalized mean value theorem of integral calculus.	10	CO1	BT1, BT3	1.1.1 2.1.1 3.2.2 4.1.2
	2(A) Test the convergence $\int_{-\infty}^{\infty} \frac{e^x}{1+e^x} dx$.	5	CO2	BT3	1.1.1 2.1.1 3.2.2 4.1.2
	2(B) Evaluate $\int_0^\pi e^{-x} \cos x dx$, after checking whether the integral converge.	5	CO2	BT4	1.1.1 2.1.1 3.2.2 4.1.2
	Q3(A) Check whether the function $f(z) = \frac{im(z)}{ z }$, $z \neq 0$, $f(z) = 0$, $z = 0$ is continuous or not at $z = 0$.	6	CO3	BT1, BT4	1.1.1 2.1.1 3.2.2 4.1.2
	3(B) Show that the function $f(z) = \frac{xy^2(x+iy)}{(x^2+y^4)}$, $z \neq 0$, $f(z) = 0$, $z = 0$ is not analytic at $z = 0$, although C-R equations are satisfied at the origin.	7	CO3	BT2, BT3	1.1.1 2.1.1 3.2.2 4.1.2

PART-D

	Show that the function $v(x, y) = \ln(x^2 + y^2) + x - 2y$ is harmonic. Find its conjugate harmonic function $u(x, y)$ and the corresponding analytic function $f(z)$.	7	CO3	BT1, BT3	1.1.1 2.1.1 3.2.2 4.1.2
Q4(A)	Prove that $\tan\left(i \log \frac{a-ib}{a+ib}\right) = \frac{2ab}{a^2-b^2}$.	5	CO3	BT2	1.1.1 2.1.1 3.2.2 4.1.2
4(B)	If the potential function is $\log(x^2 + y^2)$, find the flux function and the complex potential function.	8	CO3	BT3, BT4	1.1.1 2.1.1 3.2.2 4.1.2
4(C)	Expand the function $f(z) = \frac{5z-7}{z(z+1)(z-2)}$ when (i) $1 < z+1 < 3$ (ii) $ z+1 > 3$.	7	CO3	BT2, BT3	1.1.1 2.1.1 3.2.2 4.1.2
Q5(A)	State Cauchy's integral theorem and evaluate $\oint_C (z+1)dz$, where C is the boundary of the square whose vertices are at the points $z=0, z=1, z=1+i$, and $z=i$.	8	CO4	BT1, BT4	1.1.1 2.1.1 3.2.2 4.1.2
5(B)	Evaluate $\oint_C \frac{e^{3z}}{(z-\ln 2)^4} dz$, where C is the square with vertices at $\pm 1, \pm i$.	6	CO4	BT3	1.1.1 2.1.1 3.2.2 4.1.2
5(C)	State Morera theorem and show that by using morera theorem the function $f(z) = \frac{\sin z}{z}, z \neq 0$ & $f(z) = 1, z = 0$ is entire.	6	CO4	BT4	1.1.1 2.1.1 3.2.2 4.1.2
Q6(A)	Find the residue of the following functions at $z=0$: i) $f(z) = \operatorname{cosec}^2 x$ ii) $f(z) = \frac{1+e^z}{\sin z + z \cos z}$	6	CO4	BT1, BT4	1.1.1 2.1.1 3.2.2 4.1.2
6(B)	Evaluate $\oint_C \frac{e^{2z}}{\cos nz} dz$, where C is the circle $ z =2$ using Cauchy-Residue theorem.	7	CO4	BT1, BT3	1.1.1 2.1.1 3.2.2 4.1.2
6(C)	Evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta} d\theta$ by contour integration.	7	CO4	BT4	1.1.1 2.1.1 3.2.2 4.1.2

***** END *****



DEPARTMENT OF MATHEMATICS
"T3 Examination, May-2022"

SEMESTER	IV	DATE OF EXAM	23-05-2022
SUBJECT NAME	ADVANCED ANALYSIS	SUBJECT CODE	MAH210B
BRANCH	Mathematics	SESSION	I
TIME	3.00 Hrs.	MAX. MARKS	100
PROGRAM	B.Sc.(H) Mathematics	CREDITS	4
NAME OF FACULTY	Dr. Aparna Vyas	NAME OF COURSE COORDINATOR	Dr. Aparna Vyas <i>Yasharma</i>

Note: Part A, B, C, D: All questions are compulsory.

Q.NO.	QUESTIONS	MAR KS	CO ADDRES SED	BLOO M'S LEVE L	PI
1	State and prove generalized mean value theorem of integral calculus.	10	CO1	BT1, BT3	1.1.1 2.1.1 3.2.2 4.1.2
2(A)	Test the convergence $\int_{-\infty}^{\infty} \frac{e^x}{1+e^x} dx$.	5	CO2	BT3	1.1.1 2.1.1 3.2.2 4.1.2
2(B)	Evaluate $\int_0^{\pi} e^{-x} \cos x dx$, after checking whether the integral converge.	5	CO2	BT4	1.1.1 2.1.1 3.2.2 4.1.2
Q3(A)	Check whether the function $f(z) = \frac{\ln(z)}{ z }$, $z \neq 0$, $f(z) = 0$, $z = 0$ is continuous or not at $z = 0$.	6	CO3	BT1, BT4	1.1.1 2.1.1 3.2.2 4.1.2
3(B)	Show that the function $f(z) = \frac{xy^2(x+iy)}{(x^2+y^4)}$, $z \neq 0$, $f(z) = 0$, $z = 0$ is not analytic at $z = 0$, although C-R equations are satisfied at the origin.	7	CO3	BT2, BT3	1.1.1 2.1.1 3.2.2 4.1.2

	Show that the function $v(x, y) = \ln(x^2 + y^2) + x - 2y$ is harmonic. Find its conjugate harmonic function $u(x, y)$ and the corresponding analytic function $f(z)$.	7	CO3	BT1, BT3	1.1.1 2.1.1 3.2.2 4.1.2
Q4(A)	Prove that $\tan\left(i \log \frac{a+ib}{a+ib}\right) = \frac{2ab}{a^2-b^2}$	5	CO3	BT2	1.1.1 2.1.1 3.2.2 4.1.2
4(B)	If the potential function is $\log(x^2 + y^2)$, find the flux function and the complex potential function.	8	CO3	BT3, BT4	1.1.1 2.1.1 3.2.2 4.1.2
4(C)	Expand the function $f(z) = \frac{5z-7}{z(z+1)(z-2)}$ when (i) $1 < z+1 < 3$ (ii) $ z+1 > 3$.	7	CO3	BT2, BT3	1.1.1 2.1.1 3.2.2 4.1.2
Q5(A)	State Cauchy's integral theorem and evaluate $\oint_C (z+1)dz$, where C is the boundary of the square whose vertices are at the points $z = 0, z = 1, z = 1+i$, and $z = i$.	8	CO4	BT1, BT4	1.1.1 2.1.1 3.2.2 4.1.2
5(B)	Evaluate $\oint_C \frac{e^{3z}}{(z-\ln 2)^4} dz$, where C is the square with vertices at $\pm 1, \pm i$.	6	CO4	BT3	1.1.1 2.1.1 3.2.2 4.1.2
5(C)	State Morera theorem and show that by using morera theorem the function $f(z) = \frac{\sin z}{z}, z \neq 0$ & $f(z) = 1, z = 0$ is entire.	6	CO4	BT4	1.1.1 2.1.1 3.2.2 4.1.2
Q6(A)	Find the residue of the following functions at $z = 0$: i) $f(z) = \operatorname{cosec}^2 x$ ii) $f(z) = \frac{1+e^z}{\sin z + z \cos z}$	6	CO4	BT1, BT4	1.1.1 2.1.1 3.2.2 4.1.2
6(B)	Evaluate $\oint_C \frac{e^{2z}}{\cos nz} dz$, where C is the circle $ z = 2$ using Cauchy-Residue theorem.	7	CO4	BT1, BT3	1.1.1 2.1.1 3.2.2 4.1.2
6(C)	Evaluate $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta} d\theta$ by contour integration.	7	CO4	BT4	1.1.1 2.1.1 3.2.2 4.1.2

END

Integral

PART-D		(i) $u = 0$, when $x = 0, t > 0$ (ii) $u = \begin{cases} 1, & 0 < x < 1 \\ 0, & x \geq 1 \end{cases}$ when $t = 0$ and (iii) $u(x, t)$ is bounded.				
	3(D)	Using finite Fourier transform, find the solution of the wave equation $\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2}$ subjected to the conditions: $u(0, t) = u(\pi, t) = 0, t > 0$ $u(x, 0) = 3 \sin x + 4 \sin 4x$ and $u_t(x, 0) = 0$ for $0 < x < \pi$.	10	CO3	BT4	1.1.1 2.1.1 3.2.2
	4(A)	Show that $Z(a^n \cos n\theta) = \frac{z(z-a \cos \theta)}{z^2 - 2az \cos \theta + a^2}$.	10	CO4	BT3	1.1.1 2.1.1 3.2.2
	4(B)	If $Z(u_n) = U(z)$, then prove that $Z(u_{n-k}) = z^{-k}U(z)$, $k > 0$ and $Z(u_{n+k}) = z^k[U(z) - \sum_{n=0}^{k-1} u_n z^{-n}]$	10	CO4	BT3	1.1.1 2.1.1 3.2.2
	4(C)	Use convolution theorem to evaluate $Z^{-1}\left(\frac{z^2}{(z-a)(z-b)}\right)$	10	CO4	BT4	1.1.1 2.1.1 3.2.2
	4(D)	Using the Z-transform, solve $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$ with $u_0 = 0, u_1 = 1$,	10	CO4	BT4	1.1.1 2.1.1 3.2.2

DEPARTMENT OF MATHEMATICS
"T3 Examination, May - 2022"

SEMESTER	IV	DATE OF EXAM	25-05-2022
SUBJECT NAME	Advanced Algebra	SUBJECT CODE	MAH211B
BRANCH	Mathematics	SESSION	I
TIME	09:00-12:00 O'clock	MAX. MARKS	100
PROGRAM	B.Sc.(H) Mathematics	CREDITS	4
NAME OF FACULTY	Dr. Dinesh Tripathi	NAME OF COURSE COORDINATOR	Dr. Dinesh Tripathi <i>yusshannan</i>

Note: All questions are compulsory.

PART-A	Q.NO.	QUESTIONS	MAR KS	CO ADDRESSED	BLOO M'S LEVEL	PI
	1(A)	Let G be an abelian group of order n . Show that for every divisor m of n , G has a subgroup of order m .	5	CO1	BT3	3.1.1 4.1.1
	1(B)	Let P be a Sylow p -subgroup of G . Let $x \in N(P)$ s.t. $o(x) = p^t$, then show that $x \in P$.	5	CO1	BT3	3.1.1 4.1.1
	1(C)	Prove that the set $M := \left\{ \begin{bmatrix} a & b \\ -b & \bar{a} \end{bmatrix}; a, b \in \mathbb{C} \right\}$ is a non-commutative ring with unity under matrix addition and multiplication.	5	CO2	BT4	3.1.1 4.1.1
	1(D)	Prove that \mathbb{Z}_n is an integral domain if and only if n is prime.	5	CO2	BT3	3.1.1 4.1.1
	2	Prove the following: i. $1 + i$ is an irreducible element in $\mathbb{Z}[i]$. ii. 2 is a prime element in \mathbb{Z}_6 .	10	CO3	BT4	3.1.1 4.1.1
PART-B	3	Prove that ring of Gaussian integer is a PID.	10	CO3	BT3	3.1.1 4.1.1 4.1.2
	4	Evaluate i. $t, r \in \mathbb{Z}[i]$, if $a = 3 + 2t$ and $b = 2 - 3t$ in $\mathbb{Z}[i]$ such that $a = tb + r$, $d(r) < d(b)$. ii. $\gcd(1 + 2i, 3 + i)$ in $\mathbb{Z}[i]$ iii. $\text{lcm}(3, 4 + 5i)$ in $\mathbb{Z}[i]$	10	CO3	BT4	4.1.1 4.1.2 4.1.4

5	If R is a ring and $\langle x \rangle$ is the ideal of $R[x]$, then prove that $\frac{R[x]}{\langle x \rangle} \cong R$.	10	CO3	BT3	4.1.1 4.1.2 4.1.4
6	Find a polynomial of degree 3 irreducible over \mathbb{Z}_3 and use it to construct a field having 27 elements.	10	CO4	BT4	4.1.1 4.1.2 4.1.4
7	Prove that $\mathbb{Q}(\sqrt{2}, \sqrt[3]{3}) = \mathbb{Q}(\sqrt{2} + \sqrt[3]{3})$.	10	CO4	BT4	4.1.1 4.1.2 4.1.4
8	Prove that if K is a finite extension of F and L is a finite extension of K , then L is a finite extension of F and $[L:K][K:F] = [L:F]$.	10	CO4	BT3	4.1.1 4.1.2 4.1.4
9	i. Prove that $\sqrt{3}$ and $\sqrt[3]{5}$ is algebraic over \mathbb{Q} . ii. What is the degree of $\mathbb{Q}(\sqrt{3}, \sqrt[3]{5})$ over \mathbb{Q} ? iii. What is the basis of $\mathbb{Q}(\sqrt{3} + \sqrt[3]{5})$ over \mathbb{Q} ?	10	CO4	BT4	4.1.1 4.1.2 4.1.4

***** END *****

DEPARTMENT OF MATHEMATICS

"T3 Examination, May-2022"

SEMESTER	IV	DATE OF EXAM	27/05/2022
SUBJECT NAME	Mechanics-I	SUBJECT CODE	MAH-212B
BRANCH	MATHEMATICS	SESSION	I
TIME	9:00 AM - 12:00PM	MAX. MARKS	100
PROGRAM	B.Sc(Mathematics)	CREDITS	4
NAME OF FACULTY	Dr. Y K Sharma	NAME OF COURSE	Dr. Y K Sharma
		COORDINATOR	<u>yks</u> <u>sharma</u>

Note: All questions are compulsory.

Q.NO.	QUESTIONS	MAR KS	CO ADD RES SED	BLO OM' S LEV EL	PI
1(A)	The greatest and least resultants of two forces are of magnitude P and Q respectively. Show that when they act at an angle θ , their resultant is of magnitude $\sqrt{P^2 \cos^2 \frac{\theta}{2} + Q^2 \sin^2 \frac{\theta}{2}}$.	5	CO1	BT2	1.1.1 2.1.1 3.2.2 4.1.2
1(B)	Find the Magnitude and direction of resultant of two forces acting at a point by Parallelogram law of forces.	5	CO1	BT2	1.1.1 2.1.1 3.2.2 4.1.2
2(A)	Find the C.G of the arc of the cardioids $r = a(1 + \sin \theta)$ lying in the second	5	CO2	BT2	1.1.1 2.1.1 3.2.2 4.1.2
2(B)	Derive the centre of gravity of an arc of a plane curve.	5	CO2	BT2	1.1.1 2.1.1 3.2.2 4.1.2

3(A)	Prove that "The virtual works done by the tension in a virtual extension of a string from length l to $l + \delta l$ is $-T\delta l$, where T is the tension in the string.	10	CO3	BT4	1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
3(B)	Four equal rods, each of length $2a$ and weight W , are freely joined to form a square ABCD which is kept in shape by a light rod BD and is supported in a vertical plane with BD horizontal, A above C and AB and AD in contact with two fixed smooth pegs which are at distance $2b$ apart on the same level. Find the stress in the rod BD.	10	CO3	BT4	1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
4(A)	Find the equation of the central axis of any given system of forces acting on a rigid body.	10	CO3	BT4	1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
4(B)	Define The virtual work and also derive the measurement of work when the force acting at a point.	10	CO3	BT4	1.1.1 2.1.1 3.2.2 4.3.4
5(A)	Define Null lines and Null plane. Find the null point of the plane $lx + my + nz = 1$ for the system of forces (X, Y, Z; L, M, N).	10	CO4	BT4	1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
5(B)	Define position of equilibrium and write down the condition of stability of equilibrium.	10	CO4	BT4	1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3

11.2.2
13.1.1

6(A)	Show that a given system of forces can replaced by two forces, equivalent to the given system, in a infinite number of ways and that the tetrahedron formed by the two forces is of constant volume.	10	CO4	BT4
6(B)	Show that the minimum distance between two forces which are equivalent to a given system (R.K) and which are inclined at a given angle 2α is $2K/R \cot\alpha$ and the forces are then each equal to $(R/2) \sec\alpha$	10	CO4	BT4

***** END *****

DEPARTMENT OF MATHEMATICS
"T3 Examination, May-2022"

SEMESTER	IV & VI	DATE OF EXAM	31-05-2022
SUBJECT NAME	Integral Transforms and Applications	SUBJECT CODE	MAH213B
BRANCH	MATHEMATICS	SESSION	I
TIME	9:00 AM-12:00 NOON	MAX. MARKS	100
PROGRAM	B.Sc. (H)	CREDITS	4
NAME OF FACULTY	Dr. Kamlesh Kumar	NAME OF COURSE COORDINATOR	Dr. Kamlesh Kumar <i>[Signature]</i>

Note: All questions are compulsory.

Q.NO.		QUESTIONS	MARK S	CO ADDRESSED	BLOOM 'S LEVEL	PI
PART-A	1(A)	Find the Laplace transform of $\cos^2 t$.	5	CO1	BT2	1.1.1 2.1.1 3.2.2
	1(B)	Find the Laplace transform of $\frac{1-\cos t}{t^2}$.	5	CO1	BT2	1.1.1 2.1.1 3.2.2
PART-B	2(A)	Find the Fourier series representing $f(x) = x$, $0 < x < 2\pi$.	5	CO2	BT3	1.1.1 2.1.1 3.2.2
	2(B)	Expand for $f(x) = k$ for $0 < x < 2$ in a half range sine series. Where k is constant.	5	CO2	BT3	1.1.1 2.1.1 3.2.2
PART-C	3(A)	Find Fourier sine transform of $\frac{1}{x(x^2+a^2)}$.	10	CO3	BT3	1.1.1 2.1.1 3.2.2
	3(B)	Using Parseval's identities, prove that $\int_0^{\infty} \frac{dt}{(4+t^2)(9+t^2)} = \frac{\pi}{60}$	10	CO3	BT3	1.1.1 2.1.1 3.2.2
	3(C)	Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ $x > 0, t > 0$ subjected to the conditions	10	CO3	BT4	1.1.1 2.1.1 3.2.2

		(i) $u = 0$, when $x = 0, t > 0$ (ii) $u = \begin{cases} 1, & 0 < x < 1 \\ 0, & x \geq 1 \end{cases}$ when $t = 0$ and (iii) $u(x, t)$ is bounded.			
	3(D)	Using finite Fourier transform, find the solution of the wave equation $\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial x^2}$ subjected to the conditions: $u(0, t) = u(\pi, t) = 0, t > 0$ $u(x, 0) = 3 \sin x + 4 \sin 4x$ and $u_t(x, 0) = 0$ for $0 < x < \pi$.	10	CO3	BT4
PART-D	4(A)	Show that $Z(a^n \cos n\theta) = \frac{z(z-a \cos \theta)}{z^2 - 2az \cos \theta + a^2}$.	10	CO4	BT3
	4(B)	If $Z(u_n) = U(z)$, then prove that $Z(u_{n-k}) = z^{-k}U(z)$, $k > 0$ and $Z(u_{n+k}) = z^k[U(z) - \sum_{n=0}^{k-1} u_n z^{-n}]$	10	CO4	BT3
	4(C)	Use convolution theorem to evaluate $Z^{-1}\left(\frac{z^2}{(z-a)(z-b)}\right)$	10	CO4	BT4
	4(D)	Using the Z-transform, solve $u_{n+2} + 4u_{n+1} + 3u_n = 3^n$ with $u_0 = 0, u_1 = 1$,	10	CO4	BT4

DEPARTMENT OF MATHEMATICS

"T3 Examination, May-2022"

SEMESTER	IV	DATE OF EXAM	02/06/2022
SUBJECT NAME	SET & NUMBER THEORY	SUBJECT CODE	MAH214B
BRANCH	MATHEMATICS	SESSION	I
TIME	9:00 AM - 12:00 PM	MAX. MARKS	100
PROGRAM	B.Sc. (H)	CREDITS	4
NAME OF FACULTY	MR. RAMAPATI MAURYA	NAME OF COURSE COORDINATOR	MR. RAMAPATI MAURYA <i>YK Sharma</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARK S	CO ADD RESS ED	BLO OM' S LEV EL
PART-A	1(a)	Explain denumerable set. Show that the set of all rational numbers in the interval (0, 1) is a denumerable or countably infinite set.	5	CO1	BT2
	1(b)	Prove that the relation R " $a - b$ is divisible by 3" $\forall a, b \in \mathbb{Z}^+$ (set of positive integers) is an equivalence relation. Also describe the distinct equivalence classes of R .	5	CO1	BT3
PART-B	2(a)	Prove that number of primes is infinite.	5	CO2	BT3
	2(b)	If a and b are relatively prime, then prove that any common divisor of ac and b is a divisor of c .	5	CO2	BT3
PART-C	3(a)	If p is a prime and k be any positive integer, then prove that $\phi(p^k) = p^k - p^{k-1}$. Hence for any positive integer $n \geq 1$, Show that $\phi(n) = \prod_{(p n)} \left(1 - \frac{1}{p}\right)$.	6	CO3	BT4
	3(b)	Find the highest power of 6 contained in $500!$.	7	CO3	BT3
	3(c)	For any positive real numbers x and y , prove that $ x - y \leq x - y \leq x - y + 1$.	7	CO3	BT3
	4(a)	If p and $p + 2$ both are primes, then show that $\phi(p + 2) = \phi(p) + 2$.	4	CO3	BT4

PART-D

4(b)	If an integer $n > 1$ has r distinct prime factors $p_1, p_2, p_3, \dots, p_r$, then show that $\sum_{(d n)} \frac{\mu(d)}{d} = \prod_{i=1}^r \left(1 - \frac{1}{p_i}\right)$.	8	CO3	BT3
4(c)	If n is an integer ≥ 1 , then show that $\sum_{(d n)} \mu\left(\frac{n}{d}\right) d(d) = 1$.	8	CO3	BT3
5(a)	Prove that if the congruence $x^2 \equiv a \pmod{p}$, $(a, p) = 1$ is solvable then it has exactly two incongruent solutions.	10	CO4	BT3
5(b)	State Euler's criterion for the quadratic residues. Hence show that 3 is a quadratic residue of 23.	5	CO4	BT4
5(c)	Let p be an odd prime and a, b be any integers co-prime to p then prove that $\left(\frac{ab}{p}\right) = \left(\frac{a}{p}\right)\left(\frac{b}{p}\right)$.	5	CO4	BT4
6(a)	State Gauss quadratic reciprocity law. Hence prove that if at-least one of the primes p and q is of the form $4k+1$, then $\left(\frac{p}{q}\right) = \left(\frac{q}{p}\right)$, where $(.)$ denotes the Legendre symbol.	6	CO4	BT3
6(b)	Find all the primes p such that $x^2 \equiv 5 \pmod{p}$ is solvable.	7	CO4	BT3
6(c)	Find all the primitive roots of 10.	7	CO4	BT3



DEPARTMENT OF MATHEMATICS

"T3 Examination, May-2022"

SEMESTER	VI	DATE OF EXAM	24/05/2022
SUBJECT NAME	DISCRETE MATHEMATICS	SUBJECT CODE	MAH311B
BRANCH	MATHEMATICS	SESSION	I
TIME	09:00 AM - 12:00 PM	MAX. MARKS	100
PROGRAM	B.Sc. (H)	CREDITS	4
NAME OF FACULTY	MR. RAMAPATI MAURYA	NAME OF COURSE COORDINATOR	MR. RAMAPATI MAURYA <i>yasharma</i>

Note: All questions are compulsory.

Q.NO.	QUESTIONS	MA RK S	CO ADD RES SED	BLO OM' S LEV EL	P I
PART-A 1(a)	Regarding POSET $(\{\{1\}, \{2\}, \{4\}, \{1,2\}, \{1,4\}, \{2,4\}, \{3,4\}, \{1,3,4\}, \{2,3,4\}, \subseteq)$, answer the following questions: (i) Find the maximal and minimal elements. (ii) Find all the upper bounds of $\{\{2\}, \{4\}\}$ and lub. (iii) Find all the lower bounds of $\{1,3,4\}$ and glb of the same.	5	CO1	BT2	
PART-B 1(b)	If R be a relation in the set of integers Z defined by $R = \{(x, y) : x \in Z, y \in Z, (x - y) \text{ is divisible by } 6\}$ then prove that R is an equivalence relation. Also describe the distinct equivalence classes of R	5	CO1	BT3	
PART-C 2(a)	Solve the recurrence relation $a_{n+1} - 2a_n = 3 + 4^n$ satisfying the condition $a_0 = 2$.	5	CO2	BT3	
2(b)	State and prove De' Morgan's law in Boolean algebra. Also, verify the same using truth table.	5	CO2	BT3	
3(a)	Write converse, inverse and contrapositive to the following statements: (i) If $x + 4 = 10$ then $x = 6$. (ii) If I run fast then I can win the race.	6	CO3	BT4	
3(b)	Using laws of algebra of propositions, show that (i) $\sim(p \vee (\sim p \wedge q)) \equiv \sim p \wedge q$.	7	CO3	BT3	

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

3(C)	Determine whether the following proposition is a tautology: $[(p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)] \rightarrow r.$	7	CO3	BT3
4(a)	Test the validity of the argument: $\begin{array}{c} p \rightarrow q, \\ q \rightarrow r, \\ r \rightarrow s \wedge t, \\ \hline p \\ s \end{array}$	7	CO3	BT4
4(b)	Check the validity of the following argument: "If I try hard and I have a talent then I will become a scientist. If I become a scientist then I will be happy. Therefore, if I will not be happy then I did not try hard or I do not have talent."	7	CO3	BT4
4(c)	Obtain disjunctive normal form of the following statements: (i) $\neg(p \vee q) \leftrightarrow (p \wedge q)$ (ii) $(p \wedge \neg(q \wedge r)) \vee (p \leftrightarrow q).$	6	CO3	BT4
5(a)	Draw the multigraph G whose adjacency matrix is $M_G = \begin{bmatrix} 1 & 3 & 0 & 0 \\ 3 & 0 & 1 & 1 \\ 0 & 1 & 2 & 2 \\ 0 & 1 & 2 & 0 \end{bmatrix}$. Also, discuss an application of multigraph in real life.	4	CO4	BT3
5(b)	Give an example of a graph that has (i) Eulerian circuit which is also a Hamiltonian cycle. (ii) Hamiltonian circuit but not an Eulerian circuit.	6	CO4	BT4
5(c)	Using Dijkstra's algorithm, find the shortest path between a and g in the following graph:	10	CO4	BT4
6(a)	Show how Kruskal's algorithm finds a minimal spanning tree of the following graph:	8	CO4	BT4

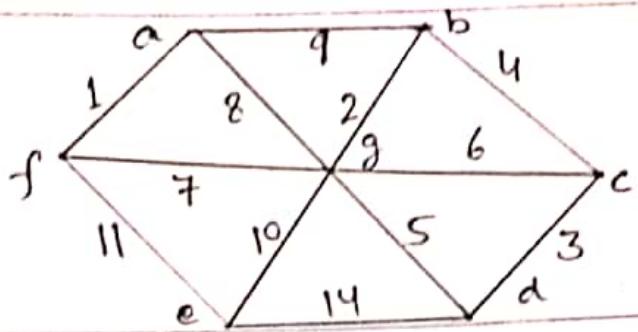
		Y →			Marginal Probability of Y
X ↓		0	1	2	
0	0.1	0.2	0.1	0.4	
	0.2	0.3	0.1	0.6	
Marginal Probability of Y	0.3	0.5	0.2		

Conditional Probability Distribution of X given Y > 0

Y = 1	X = 0	0.4
Y = 1	X = 1	0.6
Y = 2	X = 0	0.5
Y = 2	X = 1	0.5

Expectation	Value
$E(X)$	0.6
$E(Y)$	0.9
$E(X^2)$	0.6
$E(Y^2)$	1.3
$E(X \cdot Y)$	0.5

Var(X)	0.24
Cov(X, Y)	-0.04



Explain the following terms regarding graph:

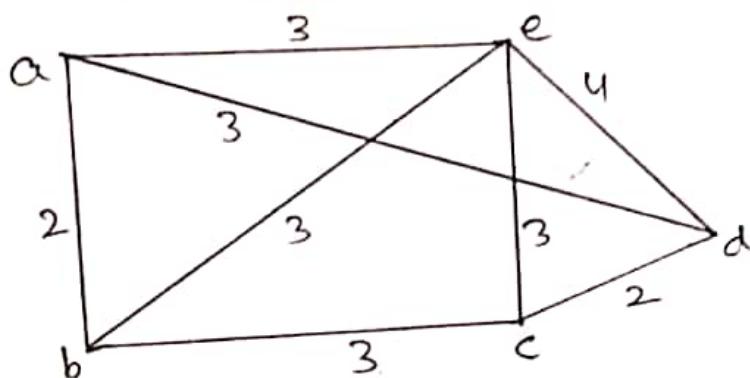
6(b)

- (i) Proper colouring
- (ii) Chromatic Number

4 CO4 BT2

Find by Prim's algorithm, a minimal spanning tree of the following graph:

6(c)



8 CO4 BT4

Q4. Find the Joint distribution table for the following.

Q5. Find marginal table for the following.

Gender	Rank			Total
	R1	R2	R3	
Male	30	80	90	200
Female	20	40	40	100
Total	50	120	130	200

Gender	Rank			Total	Marginal Probability of X
	R1	R2	R3		
Male	30	80	90	200.00	0.67
Female	20	40	40	100.00	0.33
Total	50.00	120.00	130.00	300.00	
Marginal Probability of X	0.17	0.40	0.43		

DEPARTMENT OF MATHEMATICS
"T3 Examination, March-2022"

SEMESTER	VI	DATE OF EXAM	26/05/2022
SUBJECT NAME	LPP & Game Theory	SUBJECT CODE	MAH309B
BRANCH	BSc(H).Maths	SESSION	I
TIME	9:00AM-12:00PM	MAX. MARKS	100
PROGRAM	BSc.(H)Maths	CREDITS	4
NAME OF FACULTY	Dr.Ruchi Gupta	NAME OF COURSE COORDINATOR	Dr.Ruchi Gupta <i>YKSharma</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADD RESS ED	BL OO M S LE VE L	PI
PART-A	Q1	<p>A company has two grades of inspectors 1 and 2 who are to be assigned to a quality inspection work. It is required that at least 18.00 pieces are inspected per 8-hour day. Grade 1 inspectors can check pieces at the rate of 25 per hour with an accuracy of 98%. Grade 2 inspectors can check at the rate of 15 pieces per hour with an accuracy of 95%. The wage rate for grade 1 inspector is Rs.40 per hour while that of grade 2 is Rs. 30 per hour. Each time an error is caused by the inspectors. The company wants to determine the optimal assignment of inspectors to minimize total inspection cost. Formulate it as LPP and solve using graphical method.</p>	10	CO4	BT 4	1.1.3
PART-B	Q2	<p>Solve the following travelling salesman problem so as to minimize the cost per cycle:</p>	10	CO2	BT 4	11.2. 2

From	To				
	A	B	C	D	E
A	-	6	12	6	4
B	6	-	10	5	4
C	8	7	-	11	3
D	5	4	11	-	5
E	5	2	7	8	-

Solve the following game by Simplex method:

$$\begin{array}{ccc} -1 & 2 & 1 \\ 1 & -2 & 2 \\ 3 & 4 & -3 \end{array}$$

15 CO3 BT 3 1.1.1

(B)

Two players A and B match coins. If the coin match, then A wins one units, if the coins do not match, then B wins one unit of value. Determine optimum strategies for the players and the value of the game.

5 CO4 BT 4 1.1.3

Solve the game using dominance principle:

A	B					
	I	II	III	IV	V	VI
I	0	0	0	0	0	0
II	4	2	0	2	1	1
III	4	3	1	3	2	2
IV	4	3	7	-5	1	2
V	4	3	4	-1	2	2
VI	4	3	3	-2	2	2

10 CO2 BT 3 11.2.2

Q4(A)

Let $A = \{a_{ij}\}$ be an $m \times n$ payoff matrix for a zero-sum two-person game. Define a Saddle point for matrix A and show that the value of the game is equal to the saddle value.

10 CO1 BT 2 1.1.1

(B)

We have five jobs, each of which must go through the machines A, B and C in the order ABC, processing times are:

Jobs	1	2	3	4	5
Machine A	4	9	8	6	5
Machine B	5	6	2	3	4
Machine C	8	10	6	7	11

10 CO2 BT 3 1.1.3

Determine a sequence for the five jobs that will minimize the elapsed time T. Also find Ideal time.

We have 4 jobs each of which go through the machine $M_j (j=1,2,3,4,5,6)$ in order $M_1, M_2, M_3, \dots, M_6$ processing time (in hours) is given below:

Jobs	M_1	M_2	M_3	M_4	M_5	M_6
A	18	8	7	2	10	25
B	17	6	9	6	8	19
C	11	5	8	5	7	15
D	20	4	3	4	8	12

Determine a sequence of these four jobs that minimizes the total elapsed time T. Also find Ideal time.

Q6(A) Give the Johnson's method for determining an optimal sequence for processing. And explain what 'no passing rule' is in a sequencing algorithm?

Find the sequence that minimizes the total elapsed time required to complete the following tasks on two machines and find Ideal time :

Tas k	A	B	C	D	E	F	G	H	I
Mac hine (I)	2	5	4	9	6	8	7	5	4
Mac hine (II)	6	8	7	4	3	9	3	8	11

***** END *****

10 CO2 BT 3 11.2. 2

10 CO1 BT 2 1.1.1

10 CO3 BT 3 11.2. 2

DEPARTMENT OF MATHEMATICS
"T3 Examination, June-2022"

SEMESTER	II	DATE OF EXAM	23-06-2022
SUBJECT NAME	Field Theory	SUBJECT CODE	MAH507B
BRANCH	Mathematics	SESSION	I
TIME	8:30AM-11:30 AM	MAX. MARKS	100
PROGRAM	M.Sc. Mathematics	CREDITS	4
NAME OF FACULTY	Dr. Kamlesh Kumar	NAME OF COURSE COORDINATOR	Dr. Kamlesh Kumar <i>YKSharma</i>

Note: Part A, B, C: All questions are compulsory.

	Q.NO.	QUESTIONS	MAR KS	CO ADDRESSED	BLOO M'S LEVEL	PI
PART-A	1(A)	Determine the degree $[\mathbb{Q}(\sqrt{3 + 2\sqrt{2}}) : \mathbb{Q}]$	5	CO1	BT1	PI 1.1.1 PI 2.1.1
	1(B)	Show that an algebraic extension of a perfect field is perfect.	5	CO1 CO2	BT2	PI 1.1.1 PI 2.1.1
PART-B	2(A)	Determine the automorphisms of the extension $\mathbb{Q}(\sqrt[4]{2})/\mathbb{Q}(\sqrt{2})$ explicitly.	5	CO2	BT1	PI 1.1.1 PI 2.1.1 PI 4.3.1
	2(B)	Give an example to show that a normal extension of a normal extension need not be a normal extension.	5	CO2	BT2	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.4.1
PART-C	3(A)	Determine the Galois group of $(x^2 - 2)(x^2 - 3)(x^2 - 5)$. Determine all the subfields of the splitting field of this polynomial.	20	CO3	BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1
	3(B)	Prove that $\mathbb{Q}(\sqrt{2})$ and $\mathbb{Q}(\sqrt{3})$ are not isomorphic.	5	CO3	BT1	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.4.1

PART-D

3(C)	Determine $[\mathbb{Q}(\xi_7, \xi_3) : \mathbb{Q}(\xi_3)]$ or calculate $\Phi_{16}(x)$.	5	CO3	BT1	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1
3(D)	Write the symmetric polynomials $f(x, y, z) = x^2y^2 + y^2z^2 + z^2x^2$ and $g(x, y, z) = x^3y + xy^3 + x^3z + xz^3 + y^3z + yz^3$ in terms of elementary symmetric polynomials.	10	CO3	BT2	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1
4(A)	If a is a positive constructible real number then show that \sqrt{a} is also constructible.	10	CO4	BT1	PI 1.1.1 PI 2.1.1 PI 4.3.1
4(B)	Show that it is impossible to trisect an arbitrary angle θ with ruler and compass.	10	CO4	BT2	PI 1.1.1 PI 2.1.1 PI 4.3.1
4(C)	Let p be a prime number and $\xi_p = \cos 2\pi/p^2 + i \sin 2\pi/p^2$. Then determine degree $[\mathbb{Q}(\xi_p) : \mathbb{Q}]$.	10	CO4	BT2	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1
4(D)	Prove that it is impossible to contract the regular 9-gon.	10	CO4	BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1

***** END *****

DEPARTMENT OF MATHEMATICS
"T3 Examination, JUNE-2022"

SEMESTER	II	DATE OF EXAM	27/06/2022
SUBJECT NAME	Complex Analysis	SUBJECT CODE	MAH 508B
BRANCH	MATHEMATICS	SESSION	Ist
TIME	8.30AM - 11.30AM	MAX. MARKS	100
PROGRAM	M.Sc.(Mathematics)	CREDITS	4
NAME OF FACULTY	Dr. Y K Sharma	NAME OF COURSE COORDINATOR	Dr. Y K Sharma <i>yks</i>

Note: All questions are compulsory.

Q.NO.	QUESTIONS	MAR KS	CO ADD RES SED	BLO OM' S LEV EL	PI
1(A)	Evaluate $\int_{1-i}^{2+3i} (z^2 + z) dz$ along the line joining the points (1,-1) and (2,3).	5	CO1	BT2	1.1.1 2.1.1 3.2.2 4.1.2
1(B)	State and prove C R equation in Cartesian coordinates	5	CO1	BT2	1.1.1 2.1.1 3.2.2 4.1.2
2(A)	Using the residue theorem, evaluate $\int_C \frac{2z-1}{z(z+1)(z-3)} dz$, where c is the circle $ z-1 =3$	5	CO2	BT2	1.1.1 2.1.1 3.2.2 4.1.2
2(B)	Expand $\frac{\sin z}{z-\pi}$ about $z=\pi$	5	CO2	BT2	1.1.1 2.1.1 3.2.2 4.1.2

							1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
3(A)	State and prove Uniqueness of analytic continuation theorem.	10	CO3	BT4			1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
3(B)	Show that the function $f(z)$ can be continued analytically. Also construct a power series which is analytic continuation of $f_1(z)$.	10	CO3	BT4			1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
4(A)	If $f(\bar{z}) = f(z)$ then prove that $f(x)$ is real.	10	CO3	BT4			1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
4(B)	Explain the following with examples (i). Analytic Continuation (ii). Complete analytic function	10	CO3	BT4			1.1.1 2.1.1 3.2.2 4.3.4
5(A)	Define Translation, Rotation and Magnification with examples.	10	CO4	BT4			1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3 11.2.2 13.1.1
5(B)	Define linear fractional transformation. Prove that "Every bilinear transformation is the resultant of bilinear transformation with simple geometric imports"	10	CO4	BT4			1.1.1 2.1.1 3.2.2 4.3.4 5.1.1 7.1.1 8.2.1 10.3.3

11.2.
13.1.

6(A)	Find the fixed points and the normal of the following bilinear transformation if the transformation is $w = \frac{z}{z-2}$.	10	CO4	BT4	
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6(B)	Prove that the cross ratio remains invariant under a bilinear transformation.	10	CO4	BT4	1.1. 2.1. 3.2. 4.3. 5.1. 7.1. 8.2. 10.3. 11.2. 13.1.
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***** END *****



DEPARTMENT OF MATHEMATICS

"T3 Examination, June-2022"

SEMESTER	II	DATE OF EXAM	29-06-2022
SUBJECT NAME	Functional Analysis	SUBJECT CODE	MAH509B
BRANCH	Mathematics	SESSION	8.30 AM-11.30 PM
TIME	3.00 Hrs.	MAX. MARKS	100
PROGRAM	M.Sc. Mathematics	CREDITS	4
NAME OF FACULTY	Dr. Aparna Vyas	NAME OF COURSE COORDINATOR	Dr. Aparna Vyas <i>yvsharma</i>

Note: Part A, B: All questions are compulsory.

	Q.NO.	QUESTIONS	MAR KS	CO ADDRESSED	BLOO M'S LEVEL	PI
PART-A	Q1	A normed space X is a Banach space if and only if and only if every absolutely summable sequence in X is summable in X.	10	CO1 & CO3	BT1, BT2	PI 1.1.1 PI 2.1.1
	Q2	Let X and Y be Banach spaces over the field K and let $B(X, Y)$ be the linear space of all bounded linear operators $T: X \rightarrow Y$. Define $\ \cdot\ : B(X, Y) \rightarrow \mathbb{R}$ by $\ T\ = \sup\{\ Tx\ _Y : x \in X, \ x\ _X \leq 1\}$. Then prove that $(B(X, Y), \ \cdot\)$ is a normed space. Furthermore, if Y is a Banach space, then prove that $B(X, Y)$ is also a Banach space.	10	CO1 & CO3	BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1
PART-B	Q3(A)	Show that the dual space of $l^p(n)$, $1 < p < \infty$ is $l^q(n)$ where $1 < q < \infty$ and $\frac{1}{p} + \frac{1}{q} = 1$.	10	CO2	BT1, BT4	PI 1.1.1 PI 2.1.1 PI 4.3.1
	3(B)	State and prove Hahn-Banach Theorem for real normed spaces.	10	CO3	BT1, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1

	Show that a closed subspace of a reflexive Banach space is reflexive.	10	C03	BT2, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1
4(B)	Let X be normed space over the field K , M a closed linear subspace of X and let $x_0 \in X - M$. If d is the distance from x_0 to M , then show that \exists a $g \in X^*$ such that (i) $g(x_0) = 1$ (ii) $g(M) = 0$ (iii) $\ g\ = \frac{1}{d}$.	10	C02, C03	BT1, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1
Q5(A)	Show that the mapping $T \rightarrow T^*$ is an isometric isomorphism of normed algebra $B(X)$ into normed algebra $B(X^*)$ which reverse products and preserves the identity operator.	10	C02, C03	BT1, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1
5(B)	Show that in a finite dimensional normed space, weak convergence implies strong convergence.	10	C03	BT2, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1
Q6(A)	Let X be an inner product space. Then show that, there exist a Hilbert space H and an isomorphism $T: X \rightarrow H$, where H is a dense subspace of H . Also show that the space H is unique except for isomorphism.	10	C01, C04	BT2, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1
6(B)	Let H be a Hilbert space. If M and N are orthogonal closed subspaces of H , then show that $M+N$ is a closed subspace of H .	10	C01, C04	BT1, BT3	PI 1.1.1 PI 2.1.1 PI 4.3.1 PI 4.1.1

***** END *****



DEPARTMENT OF MATHEMATICS
"T3 Examination, July-2022"

SEMESTER	II	DATE OF EXAM	02-07-22
SUBJECT NAME	Differential Geometry	SUBJECT CODE	MAH510B
BRANCH	Mathematics	SESSION	First
TIME	3 hrs.	MAX. MARKS	100
PROGRAM	M.Sc	CREDITS	4
NAME OF FACULTY	Dr. Advin Masih	NAME OF COURSE COORDINATOR	Dr. Advin Masih <i>yashaswini</i>

Note: All questions are compulsory.

	Q.NO.	QUESTIONS	MARKS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A)	Show that $[ik, j] * [jk, i] = \frac{\partial g_{ij}}{\partial x^k}$.	5	C01	BT3	1.1. 1. 2.1. 1
	1(B)	Show that the metric tensor g_{ij} is a covariant tensor of rank two.	5	C01	BT3	1.1. 1. 2.1. 1
PART-B	Q2(A)	Find the curvature for the curve $x = a(3t - t^3), y = 3at^2, z = a(3t + t^3)$	5	C02	BT3	1.1. 1. 2.1. 1
	2(B)	Calculate $V_p[f]$ for the function $f = 3xyz$ with $p=(1,1,0)$ and $v=(1, 0, -3)$.	5	C02	BT3	1.1. 1. 2.1. 1
PART-C	Q3(A)	Prove that the first fundamental form is invariant under a transformation of parameter.	10	C03	BT3	1.1. 1. 2.1. 1
	3(B)	Calculate the tangent and normal to the surface $x = u\cos\theta, y = u\sin\theta, z = c\theta$.	10	C03	BT3	1.1. 1. 2.1. 1

Part-D

Q4(A)	Derive the condition of orthogonality for the two directions at a point on a surface.	10	CO3	BT3	
4(B)	Find the Gaussian curvature at the point (u,v) of the surface $x = (b + a\cos u)\cos v$, $y = (b + a\cos u)\sin v$, $z = a\sin u$.	10	CO3	BT3	1.1. 1, 2.1. 1
Q5(A)	Obtain the expression for $L_2 - M_1$ and $M_2 - N_1$ in terms of L, M and N where the symbols have usual meanings.	10	CO4	BT3	1.1. 1, 2.1. 1
5(B)	Show that the lines of curvature form an isothermal net on a minimal surface.	10	CO4	BT3	1.1. 1, 2.1. 1
Q6(A)	Check whether the surface given by $e^z \cos x = \cos y$ is minimal or not?	10	CO4	BT3	1.1. 1, 2.1. 1
6(B)	Deduce $H[N, N_1, r_1] = EN - FM$ $H[N, N_2, r_2] = FN - GM.$	10	CO4	BT3	1.1. 1, 2.1. 1

END

(d) Parity check matrix						
Q4	Prove that an (n, k) linear block code is capable of correcting up to $\lfloor (d_{min} - 1)/2 \rfloor$ number of error bits for a minimum distance d_{min} . Also give an example to support.	10	CO3	L4	PI 1.1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	
Q5	Construct the standard array for a $(6,3)$ LBC with parity check matrix $\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ Using the same decode as the received vectors (i) 110011 (ii) 100001	10	CO3	L4	PI 1.1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	
Q6	For a linear block code, prove with an example that all error patterns that differ by a code word have the same syndrome.	10	CO3	L3	PI 1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	
Q7	What are burst errors? Prove that the necessary and sufficient condition for an (n, k) linear code to be able to correct all bursts of length l or less is that no burst of length $2l$ or less can be a code vector. Determine the burst length for $e = (00101101010100000)$.	10	CO4	L4	PI 1.1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	
Q8	Write a short note on Fire codes. Design a fire code considering an irreducible polynomial $p(x) = 1 + x + x^3$.	10	CO4	L4	PI 1.1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	
Q9	Consider a $(7, 4)$ cyclic code with generator polynomial $g(x) = 1 + x + x^3$. Obtain the code polynomial in a systematic form for the following sequences: (i) $1 + x^2$ (ii) $1 + x$	10	CO4	L2, L4	PI 1.1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	
Q10	Detail the encoding procedure of a BCH code. Design single and double correcting BCH codes with block length $n = 7$ find the code word in systematic form corresponding to the following messages: (i) for single error correction, message is $1 + x^2 + x^3$ (ii) for double error correction, message is $0 + 0x + 0x^2$	10	CO4	L3	PI 1.1.1 PI 1.1.2 PI 4.1.1 PI 4.1.2 PI 4.2.1 PI 4.2.2	



DEPARTMENT OF MATHEMATICS
"T3 Examination, May-2022"

SEMESTER	Fourth	DATE OF EXAM	25/05/2022
SUBJECT NAME	ADVANCED OPERATIONS RESEARCH	SUBJECT CODE	MAH614B
BRANCH	MATHEMATICS	SESSION	Morning
TIME	9:00am-12:00pm	MAX. MARKS	100
PROGRAM	M.Sc.	CREDITS	4
NAME OF FACULTY	Dr Kalpana Shukla	NAME OF COURSE COORDINATOR	Dr Kalpana Shukla <i>qkshukla</i>

Note: All questions are compulsory.

Q.NO.	QUESTIONS	MAR KS	CO ADDRESSED	BLOOM'S LEVEL	PI
PART-A	1(A) Construct the AOA network for the following activities: A<D, E; B, D<F; C<G;B,G<H;F,G<I	3	C01	BT1	[1+2]
	1(B) Discuss the application of construction of network diagram with suitable examples.	3	C01	BT2	[1.1.2]
	1(C) Find the probability of completion if scheduled time 30 days, expected time 28 days and variance 2.17.	2	C02	BT1	[1.1.1]
	1(D) Define total float and free float. Discuss their applications.	2	C02	BT1	[1.1.1]
PART-B	Q2 (A) State and discuss that replacement of items that deteriorate i.e whose maintenance cost increase with time.	3	C02	BT3	[1.1.1] 1
	Q2 (B) The maintenance cost and resale value as per year of a machine whose purchase price is Rs. 7000 is given below: M. Cost: 900 1200 1600 2100 2800 3700 4700 Running Cost: 5900	3	C02	BT3	[1.1.1] 1

PART-C

4000	2000	1200	600	500	400	400
400						

When should the machine be replaced?

State the different state of the following problem using dynamic programming approach:

$$\begin{aligned} \min Z &= y_1^2 + y_2^2 + y_3^2 \\ \text{s.t. } &y_1 + y_2 + y_3 = 10, \\ &y_1, y_2, y_3 \geq 0 \end{aligned}$$

Q2©

4

C02

BT3

[1.1.1]
]

The mean rate of arrival of planes at an airport during the peak period is 20 /hours as per Poisson distribution. During congestion the planes are forced to fly over the field in the stack awaiting the landing of other planes that had arrived earlier

(I) How many planes would be in the stack during good and in bad whether?

(ii) How much stack and landing time to allow so that priority to land out of order would have to be requested only once in 20 times?

Q3

Assume $\mu=60$ planes/hour in good whether and 30 planes/hour in bad whether.

10

C03

BT2

[2.3.1]
]

A typist at an office of a company receives on the average 20 letters per day for typing. The typist works 8 hours a day and it takes on the average 20 minutes to type a letter. The cost of a letter waiting to be mailed (opportunity cost) is 80 paise per hour and the cost of the equipment plus salary of the typist is Rs. 45 per day.

- (I) What is the typist's utilization rate?
- (II) What is the average number of letters waiting to be typed?
- (III) What is the total daily cost of waiting letters to be mailed?

Q4

10

C03

BT2

[3.1.2]
]

Assume that the good trains in a yard at the rate of 30 trains per day and suppose that the inter-arrival times follow an exponential distribution. The service time for each train is assumed to be exponential with an average of 36 minutes. If the yard can admit 9 trains at a time (there being 10 lines, one of which is reserved for shunting purposes), calculate the probability that yard is empty and find the average queue length.

Q5

10

C03

BT4

[4.1.1]
]

Q6

The linear programming problem is

$$\begin{aligned} \max Z &= 3x_1 + 5x_2 \\ \text{s.t. } &x_1 + x_2 \leq 1; 2x_1 + 3x_2 \leq 1; x_1, x_2 \geq 0. \end{aligned}$$

PART-D

Obtain the variations in C_i which are permitted without changing the optimal solution.

The linear programming problem is

$$\begin{aligned} \max Z &= 6x_1 + 8x_2 \\ \text{s.t. } 5x_1 + 10x_2 &\leq 60; 4x_1 + 4x_2 \leq 40; x_1, x_2 \geq 0. \end{aligned}$$

- (i) Apply the RHS Vector [60 40] of the constraints of the L.P.P. is changed to [40 20].
- (ii) The RHS Vector [60 40] of the constraints is changed to [20 40].

The optimal table is:

C_i	6	8	0	0	
CB	XB	Y_1	Y_2	Y_3	Y_4
8	2	0	1	$1/5$	$-1/4$
6	8	1	0	$-1/5$	$1/2$

Q7

10 C04 BT1 [1.1.1]

Obtain the necessary and sufficient conditions for the NLPP

Q8

10 C04 BT3 [4.1.1]

$$\begin{aligned} \min Z &= e^{3x_1+1} + e^{2x_2+3} \\ \text{s.t. } x_1 + x_2 &= 5; x_1, x_2 \geq 0. \end{aligned}$$

Use the method of Lagrangian multipliers to solve the following NLPP.

Q9[A]

12 C04 BT3 [1.1.1]

$$\begin{aligned} \min Z &= x_1^2 + x_2^2 + x_3^2, \\ \text{s.t. } x_1 + x_2 + 3x_3 &= 2; 5x_1 + 2x_2 + x_3 = 5; \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

Q9[B]

8 C04 BT3 [1.1.2]

***** END *****