Manipal University Jaipur

Department of Mathematics and Statistics

Summary Report

The Department of Mathematics and Statistics offers degree courses in B.Sc. (Hons.) Mathematics and M.Sc. (Mathematics). These courses have been designed in such a way that they meet the global standards of the mentioned programmes offered in other national and international universities of repute. Each of the course follow the credit base course system, wherein B.Sc. (Hons.) Mathematics course is of 148 credits and M.Sc. (Mathematics) course is of 80 credits. The course handout of each course explains the Course Outcomes (CO's), Programme Outcomes (PO's), Programme Specific Outcomes (PSO's), Assessment Plan, Syllabus, Lecture Plan, and mapping of PO's and PSO's with CO's which provides the better insight of usefulness of courses in respect to the present scenario of employability and skill enhancement.

Dr. Kalpna Sharma, Head

Department of Mathematics & Statistics

Dr. Lalita Ledwani, Dean

School of Basic Sciences

Dr. Ajay Kumar, Director

Directorate of Academics

Department of Mathematics and Statistics

PROGRAM OUTCOMES

PO.1 **Critical thinking**: Critically interpret data, write reports, and apply the basics of evidence.

PO.2 **Effective Communication**: Communicate effectively by writing, connecting people, ideas, books, media, and technology.

PO.3 **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO.4 **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO.5 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities.

PO.6 **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO.7 **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

PROGRAM SPECIFIC OUTCOMES

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

S.I.N.O.	Course CODE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	ATTAINMENT PERCENTAGE
1	MA1103	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
2	MA1104	100	100	0	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	100
3	MA1105	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	0	0	0	100
4	CA1170	100	100	0	100	100	100	100	0	0	0	0	0	100	100	100	0	0	0	100
5	CA1175	100	100	0	100	0	100	100	0	0	0	0	0	100	100	0	0	0	0	78
6	CY1003	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	0	0	0	100
7	LN1106	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	100	0	0	100
8	MA1140	100	100	100	100	100	0	0	0	0	0	0	0	100	100	100	100	0	0	100
9	MA1130	100	100	100	100	100	0	0	0	0	0	0	0	100	100	100	100	0	0	100
10	MA2112	100	0	0	100	0	0	0	0	0	0	0	0	100	100	100	100	0	0	100
11	MA2113	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
12	MA2114	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
13	MA2115	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
14	MA2116	100	0	0	100	0	0	0	0	0	0	0	0	100	100	100	100	0	0	100
15	MA2130	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
16	MA2131	100	100	33.33	100	50	100	33.33	0	0	0	0	0	0	0	0	0	0	0	74
17	MA2140	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
18	MA2141	100	100	66.67	100	50	100	33.33	0	0	0	0	0	0	0	0	0	0	0	79
19	MA1501	100	100	100	0	0	100	100	0	0	0	0	0	100	100	100	0	0	0	100
20	MA1650	100	100	100	100	100	100	0	0	0	0	0	0	100	100	100	0	0	0	100
21	MA1502	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
22	MA1503	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
23	MA1504	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
24	MA1530	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
25	MS1505	50	100	66.67	100	50	50	100	0	0	0	0	0	0	0	0	0	0	0	74
26	MS1506	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
27	MS1532	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
28	PY1511	100	100	50	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	94
29	PY1512	100	100	100	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	100
30	PY1531	100	100	100	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	100
31	MA1203	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
32	MA1204	100	0	0	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	100
33	MA1205	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
34	MA1206	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	100
35	MA1240	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
36	MA1230	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
37	MA1241	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
38	MA1231	100	0	100	0	0	0	0	0	0	0	0	0	100	100	0	0	0	0	100
39	MA2211	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
40	MA2212	100	0	0	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	100
41	MA2213	100	0	0	100	0	0	0	0	0	0	0	0	100	100	100	100	0	0	100
42	MA2214	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
43	MA2215	100	100	100	100	100	100	100	0	0	0	0	0	100	100	100	100	0	0	100
44	MA2240	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
45	MA2230	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
46	MA1601	100	100	100	100	100	100	100	0	0	0	0	0	100	0	0	0	0	0	100
47	MA1602	100	0	0	0	0	0	100	0	0	0	0	0	100	100	0	100	0	0	100
48	MS1605	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
49	MS1606	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100

50	MS1631	100	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0	0	100
51	MA1651	100	0	0	0	0	0	100	0	0	0	0	0	100	100	100	100	0	0	100
52	PY1611	100	100	0	0	100	0	100	0	0	0	0	0	100	100	100	100	0	0	100
53	PY1612	100	100	100	100	100	0	100	0	0	0	0	0	100	100	100	100	0	0	100
54	PY1631	100	100	100	100	100	0	100	0	0	0	0	0	100	100	100	100	0	0	100
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
77	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
78	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value
80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	No Value

MINIMUM ATTAINMENT VALUE	74
MAXIMUM ATTAINMENT VALUE	100
OVERALL PROGRAM ATTAINMENT	99
OVERALL PROGRAM ATTAINMENT LEVEL	3

Manipal University Jaipur

Department of Mathematics & Statistics

Following courses were run in the B. Sc. (Hons) Mathematics programme during the session 2020-21.

S. No.	Course Code	Course Name	Semester
1	MA1103	Calculus	I
2	MA1104	Discrete Mathematics Structure	I
3	MA1105	Higher Trigonometry	I
4	CA1170	Fundamentals of Computer	I
5	CA1175	Fundamentals of Computer lab	I
6	CY1003	Environmental Science	I
7	LN1106	Communicative English	I
8	MA1140	Descriptive Statistics	I
9	MA1130	Lab on Descriptive Statistics	I
10	MA1203	Differential Equations	II
11	MA1204	Number Theory	II
12	MA1205	Abstract Algebra	II
13	MA1206	Three-Dimensional Geometry	II
14	MA1240	Probability Theory & Random Variables	II
15	MA1230	Lab on Probability & Random Variables	II
16	MA1241	Applied Statistics	II
17	MA1231	Lab on Applied Statistics	II
18	MA2112	Real Analysis	III
19	MA2113	Ring & Field Theory	III
20	MA2114	Linear Programming Problems	III
21	MA2115	Data Analysis using R	III
22	MA2116	Introduction to C Language	III
23	MA2140	Distribution Theory	III
24	MA2130	Lab on Distribution Theory	III
25	MA2141	Sampling Theory	III
26	MA2131	Lab on Sampling Theory	III
27	MA2211	Multivariate Calculus	IV
28	MA2212	PDE & System of ODE	IV
29	MA2213	Linear Algebra	IV
30	MA2214	Vector Calculus & Statics	IV
31	MA2215	Mathematical Modelling	IV
32	MA2240	Statistical Inference	IV
33	MA2230	Lab on Statistical Inference	IV
34	MA1501	Discrete Mathematics Structure	V
35	MA1502	Mathematical Statistics	V
36	MA1503	Dynamics	V
37	MA1504	Numerical Methods	V
38	MA1650	Operations Research	V
39	MA1530	Numerical Methods Practical Lab	V
40	MS1505	Econometrics	V
41	MS1506	Statistical Inference: Testing of Hypothesis	V
42	MS1532	Lab on Econometric and Statistical Inference: Testing of Hypothesis	V
43	PY1511	Basic Electronics	V
44	PY1512	Solid State Physics	V
45	PY1531	Electronics Lab	V
46	MA1601	Complex Analysis	VI
47	MA1602	Introduction to Special Functions and Integral Transforms	VI
48	MA1651	Number Theory	VI
49	MS1605	Design of Experiments	VI
50	MS1606	Stochastic Processes	VI
51	MS1631	Lab on Design of Experiments	VI
52	PY1611	Atomic and Molecular Spectroscopy	VI
53	PY1612	Nuclear Physics	VI
54	PY1631	Modern Physics Lab	VI

Dr. Kalpna Sharma

Head, Department of Mathematics & Statistics

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand-out

Calculus | MA1103 | 4 Credits | 3 1 0 4

Session: July 20 – Dec 20 | Faculty: Dr. Sunil Joshi | Class: I Sem B.Sc. Math (Hons)

A. **Introduction:** This course is offered by Dept. of Mathematics & Statistics, targeting students who wish to pursue research & development in pure mathematics field. This course is important to students whom majors are mathematics as it is the first step for them to be familiar with abstract topics in calculus; mainly limit, continuity and differentiability, differential calculus, partial differentiation and integral calculus. Calculus is also an ideal capstone course for those who will go on to take postgraduate courses in mathematics.

B. **Course Outcomes:** At the end of the course, students will be able to

[1103.1] Define the basic concepts and principles of differential calculus, limit, continuity, Differentiability which enhance their employability skills.
[1103.2] Demonstrate the knowledge about the mean value theorems and convexity which enhance their problem-solving skills.
[1103.3] Understand the basics of curvature, asymptotes, and curve tracing.
[1103.4] Develop the learning skill in solving simple and partial derivative problems
[1103.5] Learn the basic of integral calculus, Beta and Gamma function.

C. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2]. Effective Communication: Communicate effectively by writing, connecting people, ideas, Books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes
[PSO.1] To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2] To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3] To develop creative thinking and the power of imagination
[PSO.4] To expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Limits, Continuity and Mean Value Theorem: Definition of limit and continuity, types of discontinuities, properties of continuous functions on a closed interval, differentiability, Rolle's theorem, Lagrange's and Cauchy's first mean value theorems, Taylor's theorem (Lagrange's form), Maclaurin's theorem and expansions, convexity, concavity and curvature of plane curves, Formula for radius of curvature in Cartesian, parametric, polar and pedal Forms, Centre of curvature, evolutes and involutes, envelopes, asymptotes, singular points, cusp, node and conjugate points, tracing of standard Cartesian, polar and parametric curves;

Partial Differentiation: First and higher order derivatives, Euler's theorem, total derivative, differentiation of implicit functions and composite functions, Taylor's theorem for functions of two variables;

Maxima & Minima: Maxima-minima for functions of two variables, necessary and sufficient condition for extreme points, Lagrange multipliers;

Integral Calculus: Reduction formulae, application of integral calculus, length of arcs, surface areas and volumes of solids of revolutions for standard curves in Cartesian and polar forms;

Beta and Gamma Functions: Beta and Gamma functions and relation between them, evaluation of integrals using Beta and Gamma functions.

. TEXT BOOKS

1. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand Publication, New Delhi, 2011.
2. P. Saxena, *Differential Calculus*, Tata McGraw Hill, New Delhi, 2014.
3. David V. Widder, *Calculus*, PHI publication, New Delhi, 2012

REFERENCE BOOKS.

1. S. Narayanan, T. K. Manicavachagom and Pillay, *Calculus I & II*, S. Viswanathan Pvt. Ltd., Chennai, 2010.
2. M. J. Strauss ,G. L. Bradley and K. J. Smith ,*Calculus*, Dorling Kindersley Pvt. Ltd., New Delhi, 2007.

F. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Limits and Continuity: Introduction of the Course	Introduction of the Course	Lecture	MA1103.1	MTE 1, ETE
2	Definition of limit and continuity	Definition of limit and continuity	Lecture	MA1103.1	MTE 1, ETE
3	types of discontinuities	types of discontinuities	Lecture	MA1103.1	MTE 1, ETE
4	properties of continuous functions on a closed interval,	properties of continuous functions on a closed interval,	Lecture	MA1103.1	MTE 1, ETE
5	differentiability	differentiability	Lecture	MA1103.1	MTE 1, ETE
6	**Tutorial Class 1**	**Tutorial Class 1**	**Tutorial**	MA1103.1	MTE 1, ETE, Assignment 1
7	Mean Value Theorems: Rolle's theorem	Rolle's theorem	Lecture	MA1103.2	MTE 1, ETE
8	Lagrange's theorem	Lagrange's theorem	Lecture	MA1103.2	MTE 1, ETE
9	Cauchy's first mean value theorems	Cauchy's first mean value theorems	Lecture	MA1103.2	MTE 1, ETE
10	Taylor's theorem (Lagrange's form)	Taylor's theorem (Lagrange's form)	Lecture	MA1103.2	MTE 1, ETE
11	Maclaurin's theorem and expansions,	Maclaurin's theorem and expansions,	Lecture	MA1103.2	MTE 1, ETE
12	**Tutorial Class 2**	**Tutorial Class 2**	**Tutorial**	MA1103.2	MTE 1, ETE, Assignment 2, Quiz 1
13	Differential Calculus: convexity	convexity	Lecture	MA1103.2	MTE 1, ETE
14	concavity and curvature of plane curves	concavity and curvature of plane curves	Lecture	MA1103.2	MTE 1, ETE
15	Formula for radius of curvature in Cartesian form	Formula for radius of curvature in Cartesian form	Lecture	MA1103.3	MTE 1, ETE
16	Formula for radius of curvature in parametric form	Formula for radius of curvature in parametric form	Lecture	MA1103.3	MTE 1, ETE

17	Formula for radius of curvature in polar and pedal Forms	Formula for radius of curvature in polar and pedal Forms	Lecture	MA1103.3	MTE 1, ETE
18	Centre of curvature,	Centre of curvature,	Lecture	MA1103.3	MTE 1, ETE
	Tutorial Class	**Tutorial Class**	**Tutorial**	MA1103.3	MTE 1, ETE, Assignment 3
19	evolutes and involutes	evolutes and involutes	Lecture	MA1103.3	MTE 2, ETE
20	envelopes,	envelopes,	Lecture	MA1103.3	MTE 2, ETE
21	asymptotes	asymptotes	Lecture	MA1103.3	MTE 2, ETE
22	singular points	singular points	Lecture	MA1103.3	MTE 2, ETE
23	cusp, node and conjugate points	cusp, node and conjugate points	Lecture	MA1103.3	MTE 2, ETE
24	tracing of standard Cartesian curve	tracing of standard Cartesian curve	Lecture	MA1103.3	MTE 2, ETE
25	tracing of standard polar curve	tracing of standard polar curve	Lecture	MA1103.3	MTE 2, ETE
26	tracing of standard parametric curves	tracing of standard parametric curves	Lecture	MA1103.3	MTE 2, ETE
27	**Tutorial Class**	**Tutorial Class**	**Tutorial**	MA1103.3	MTE 2, ETE, Assignment 4, Quiz 2
28	Partial Differentiation and Maxima & Minima: First and higher order derivatives	First and higher order derivatives	Lecture	MA1103.4	MTE 2, ETE
29	Euler's theorem	Euler's theorem	Lecture	MA1103.4	MTE 2, ETE
30	total derivative	total derivative	Lecture	MA1103.4	MTE 2, ETE
31	differentiation of implicit functions	differentiation of implicit functions	Lecture	MA1103.4	MTE 2, ETE
32	differentiation of composite functions	differentiation of composite functions	Lecture	MA1103.4	MTE 2, ETE
33	Taylor's theorem for functions of two variables	Taylor's theorem for functions of two variables	Lecture	MA1103.4	MTE 2, ETE
34	Maxima-minima for functions of two variables	Maxima-minima for functions of two variables	Lecture	MA1103.4	MTE 2, ETE

35	necessary and sufficient condition for extreme points	necessary and sufficient condition for extreme points	Lecture	MA1103.4	MTE 2, ETE
36	Lagrange multipliers;	Lagrange multipliers;	Lecture	MA1103.4	MTE 2, ETE
37	**Tutorial Class**	**Tutorial Class**	**Tutorial**	MA1103.4	
38	Integral Calculus, Beta and Gamma Functions: Reduction formulae	Reduction formulae	Lecture	MA1103.5	ETE
39	application of integral calculus	application of integral calculus	Lecture	MA1103.5	ETE
40	length of arcs	length of arcs	Lecture	MA1103.5	ETE
41	surface areas for standard curves in Cartesian form	surface areas for standard curves in Cartesian form	Lecture	MA1103.5	ETE
42	surface areas for standard curves in polar forms	surface areas for standard curves in polar forms	Lecture	MA1103.5	ETE
43	volumes of solids of revolutions for standard curves in Cartesian form	volumes of solids of revolutions for standard curves in Cartesian form	Lecture	MA1103.5	ETE
44	volumes of solids of revolutions for standard curves in polar forms	volumes of solids of revolutions for standard curves in polar forms	Lecture	MA1103.5	ETE
45	Beta and Gamma functions	Beta and Gamma functions	Lecture	MA1103.5	ETE
46	relation between Beta and Gamma functions	relation between Beta and Gamma functions	Lecture	MA1103.5	ETE
47	evaluation of integrals using Beta and Gamma functions	evaluation of integrals using Beta and Gamma functions	Lecture	MA1103.5	ETE
48	**Tutorial Class**	**Tutorial Class**	**Tutorial**	MA1103.5	
49	Revision Class	Revision Class	**Tutorial**	MA1103.5	ETE
50	Revision Class	Revision Class	**Tutorial**	MA1103.5	ETE

G. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA1103.1	Define the basic concepts and principles of differential calculus, limit, continuity, Differentiability which enhance their employability skills.	1	2	2	1		2	2	2	1	1	1
MA1103.2	Demonstrate the knowledge about the mean value theorems and convexity which enhance their problem-solving skills.	1	2	2	1		2	2	2	1	1	1
MA1103.3	Understand the basics of curvature, asymptotes and curve tracing.	1	2	2	1		2	2	2	1	1	1
MA1103.4	Develop the learning skill in solving simple and partial derivative problems	1	2	2	1		2	2	2	1	1	1
MA1103.5	Learn the basic of integral calculus, Beta and Gamma function.	1	2	2	1		2	2	2	1	1	1

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand-out

Discrete Mathematics structure | MA1104 | 4 Credits | 3 1 0 4

Session: July 20 – Dec 20 | Faculty: Dr. Dasari Nagaraju| Class: B.Sc (Hons) I Semester

A. **Introduction:** This course is offered by Dept. of Mathematics & Statistics as a regular course, targeting students who wish to pursue BSc, in Mathematics Hons. It offers in depth knowledge of sets, relations, functions, Basic counting techniques, propositional and predicate and propositional logic, basic/introductory level algebraic structures and basic/introductory level graph theory. Students are expected to have background knowledge on number system. This course is a carefully selected blend of theory and practical, real-world applications which prepares for specialist professional employment.

B. **Course Outcomes:** At the end of the course, students will be able to

[MA1104.1] Describe the concept of Sets, Functions, Relations and their applications.

[MA1104.2] To interpret the basic counting techniques and their applications to evaluate the relevant problems.

[MA1104.3] Demonstrate knowledge of Recurrence relations and the evaluation of problems by generating functions.

[MA1104.4]. Describe the concept of Predicates, logics, Boolean Algebra and their properties which enhance the logical and programming skills and make them employable in the relevant industry.

[MA1104.5] **Describe** the concept of Algebraic structure and Group theory which helps to increase the logical skills.

[MA1104.6] Describe the concepts of Graph Theory and apply the graph algorithms to evaluate and analyze the problems, which enhance the analytical skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

MA1104: DISCRETE MATHEMATICS STRUCTURE [3 1 0 4]

Set Theory: Definition of sets, Venn diagrams, complements, Cartesian products, power sets, counting principle, cardinality and countability, proofs of some general identities on sets, pigeonhole principle; Relation: Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation; Algebraic Structure: Binary composition and its properties definition of algebraic structure, semi group, monoid, abelian group, properties of groups, permutation groups, sub group, cyclic group; Propositional Logic: Propositional logic, applications of propositional logic, propositional equivalences, topologies and contradiction, CNF and DNF, predicates and quantifiers; Combinatory: Basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of generating function, solution of recurrence relation using generating function; Graph Theory: Graph terminology and special types of graphs, representing graphs and graph isomorphism, connectivity, Euler and Hamilton paths, planar graphs.

F. Text Books:

1. Kenneth H. Rosen, "Discrete Mathematics and its applications", Seventh Edition, McGraw Hill, 2014.
2. Narsing Deo, "Graph Theory with applications to engineering and Computer Science", PHI, 2004.

G. REFERENCE BOOKS

1. Reinhard Diestel, "Graph Theory", Springer International Edition, 2005.
2. Bernard Kolman, Robert C. Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", Pearson Education, 2004.
3. J.P. Tremblay, R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw-Hill, 2006.

H. Lecture Plan:

Lecture No.	Description of the syllabus	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Introduction to **set theory**	To know about the sets and their applications	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
2.	Set and set operations, Complements, Venn diagram	To know about the sets and their applications	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
3.	Cardinality and countability, Power Sets, Partitions	To solve the counting problems	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
4.	Principle of inclusion and exclusion	To solve the counting problems	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
5.	Principle of inclusion and exclusion	To solve the counting problems	Lecture	**MA1104.1**	Quiz Mid Term

					End term Exam
6.	Cartesian product of sets and binary relations	To understand about the basic of relations theory	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
7.	Domain, co-domain and range **of relations**	To understand about the basic of relations theory	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
8.	Types of the relations	To understand the different kinds of relations on sets	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
9.	Pictorial and matrix representation of relations	How to represent the relations in different methods	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
10.	Equivalence relations	To solve the different problems depending upon the partitions	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
11.	Equivalence classes, partition	To solve the different problems depending upon the partitions	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
12.	Partial ordering relation, partially ordered set	To solve the different problems depending upon the partitions	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
13.	**Functions**-Definitions, one-to-one onto	The basic concept of function theory	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
14.	Composition of Functions, inverse of a function	The basic concept of function theory	Lecture	**MA1104.1**	Quiz Mid Term End term Exam
15.	**Combinatorics**: Basic Principle of Counting-Product rule, Sum rule	To solve the problems of counting	Lecture	**MA1104.2**	Quiz Mid Term End term Exam
16.	Review on Permutations and Combinations	To solve the problems of counting	Lecture	**MA1104.2**	Quiz Mid Term End term Exam
17.	Problems under Permutations and Combinations	To solve the problems of counting	Lecture	**MA1104.2**	Quiz Mid Term End term Exam
18.	Problems under Permutations and Combinations	To solve the problems of counting	Lecture	**MA1104.2**	Quiz Mid Term End term Exam
19.	Pigeon-hole principle	To solve the problems of counting	Lecture	**MA1104.2**	Quiz Mid Term End term Exam
20.	Pigeon-hole principle	To solve the problems of counting	Lecture	**MA1104.2**	Quiz Mid Term End term Exam
21.	Discrete Numeric function definition and examples, sum and product of DNFs	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam

22.	Discrete Numeric function definition and examples, sum and product of DNFs	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam
23.	Definition of Generating Function, examples, finding generating function for the sequence of real numbers	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam
24.	Generating function for the sequence of real numbers	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam
25.	Recurrence relations - formulation of recurrence relations	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam
26.	Solution of recurrence relations using generating functions	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam
27.	Solution of recurrence relations using generating functions	To derive and solution of recurrence functions	Lecture	**MA1104.3**	Quiz Mid Term End term Exam
28.	**Group theory;** Binary Composition, Semi-groups, monoids definition and examples	Basic idea of Algebraic structure and Group properties	Lecture	**MA1104.5**	Quiz Mid Term End term Exam
29.	Group definitions and examples, some basic theorems	Basic idea of Algebraic structure and Group properties	Lecture	**MA1104.5**	Quiz Mid Term End term Exam
30.	Group and their properties	How to solve the numerical problems related to groups	Lecture	**MA1104.5**	Quiz Mid Term End term Exam
31.	Group and their properties	How to solve the numerical problems related to groups	Lecture	**MA1104.5**	Quiz Mid Term End term Exam
32.	Cyclic groups	How to solve the numerical problems related to groups	Lecture	**MA1104.5**	Quiz Mid Term End term Exam
33.	Sub group groups	How to solve the numerical problems related to groups	Lecture	**MA1104.5**	Quiz Mid Term End term Exam
34.	Propositions, conjunction and disjunction of propositions, negation of a proposition, implications,	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam
35.	Converse, contrapositive and inverse of a proposition,	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam

	contradiction and tautology				
36.	contradiction and tautology, logical equivalences	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam
37.	Predicates - ways of expressing sentences using predicates	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam
38.	Predicates - ways of expressing sentences using predicates	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam
39.	Quantifiers - expressing sentences using predicates and quantifiers and quantified express into sentences	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam
40.	Quantifiers - expressing sentences using predicates and quantifiers and quantified express into sentences	To enhance the logical skills	Lecture	**MA1104.4**	Quiz Mid Term End term Exam
41.	Graphs, digraphs, Simple graph, multi graph, pseudo graph	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
42.	Degree of a vertex in a graph, adjacency and incidence.	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
43.	Some basic properties, Subgraphs	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
44.	Complete graphs, bipartite graphs	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
45.	Graph isomorphism	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
46.	Walk, path, cycle in a graph.	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
47.	Eulerian and Hamiltonian walk.	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam
48.	Planar graphs	To apply the graph algorithms and analyze the problem	Lecture	**MA1104.6**	Quiz Mid Term End term Exam

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
[1104.1]	Describe the concept of Sets, Functions, Relations and their applications.	**2**	**2**	**1**	**2**	**1**			3	1	1	2
[1104.2]	Describe basic counting techniques and their applications to evaluate the relevant problems.	**2**	**3**		**3**				3	1	1	2
[1104.3]	Describe the concepts of Recurrence relations and the evaluation of problems by generating functions.	2	**3**	**2**	**3**				3	1	1	2
[1104.4]	Describe the concept of Predicates, logics, Boolean Algebra and their properties which enhance the logical and programming skills and make them employable in the relevant industry.	**1**	**3**		**2**				3	1	1	2
[1104.5]	Describe the concept of Algebraic structure and Group theory which helps to increase the logical skills.	**2**	**3**		**3**				3	1	1	2
[1104.6]	Describe the concepts of Graph Theory and apply the graph algorithms to evaluate and analyze the problems, which enhance the analytical skills.	**2**	**3**		**2**				3	1	1	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics and
Statistics Course Hand-out

Higher trigonometry | MA 1105| 4 Credits | 3 1 0 4

Session: Jul 20 – Dec 20 | Faculty: Dr. Anamika Jain | Class: B. Sc. (Maths Hons.) I Sem.

A. Introduction: This course is offered by Dept. of Mathematics and Statistics for Mathematics (Hons.) students, targeting students who wish to pursue research& development in industries or higher studies in field of Mathematics and Engineering. Offers in depth knowledge of difference equation, De Moiver's theorem, Exponential function and Logarithmic function and gives an introductory level knowledge on higher trigonometry. Students are expected to have background knowledge on solving algebraic equations, trigonometric functions, derivatives for a better learning.

B. Course Outcomes: At the end of the course, students will be able to

[1105. 1] Solve problems based on complex numbers and employ to use the concepts in the relevant field.

[1105.2] Learn to apply the De-moivre's theorem in various problems like expansion of sin nx, con nx etc.

[1105.3] Employ the concept of complex number theory to solve problems related to trigonometric functions that will enhance thinking skills.

[1105.4] Solve the mathematical problems related to hyperbolic and exponential functions.

[1105.5] Use the properties and different standard results of logarithmic functions in their relevant field.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

The PO's of B.Sc in Mathematics programme are

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

The PSO's of B.Sc in Mathematics programme are :

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	20
	Sessional Exam II (Open Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Open Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

MA1105 Higher Trigonometry and Difference Equations [3 1 0 4]

Complex Numbers: Introduction of complex numbers, properties of complex numbers, geometrical representation of a complex number, geometrical interpretation of complex numbers; De Moivre's Theorem: Statement and proof of De Moivre's theorem for integral indices, alternative method, Proof for rational indices, all possible values of , application of De- Moivre's theorem for integral and fractional indices; Trigonometric Functions: Circular trigonometric functions, trigonometric functions of related angles, properties of

trigonometric functions, trigonometric identities, inverse functions, summation of series; Hyperbolic and Exponential Functions: Definitions of exponential and hyperbolic functions, laws of exponential and hyperbolic functions; Inverse functions, Summation of series; Logarithm: Definition, properties of logarithms, change of base, two systems of logarithms, use of logarithmic table, antilogarithms, Exponential and logarithmic series. □ □ / cos sin p q x i x □

References:

1. R. Mazumdar, A. Dasgupta and S. B. Prasad, Degree Level Trigonometry, Bharti Bhawan, Patna, 2012.
2. Lalji Prasad, Higher Trigonometry, Paramount publications, Patna, 2016.
3. V. K. Parashar, Applied Mathematics, Galgotia Publications pvt. Ltd, 2005.
4. S. L. Loney, Plane Trigonometry, University of Michigan Library, 2005.
5. R. K. Ghosh and K. C. Maity, Higher Algebra, New Central Book Agency, Kolkata, 2013.
6. T. Veerarajan and T. Ramachandran, Numerical Methods, Tata McGraw Hill, New Delhi, 2009.
7. W. G. Kelley and A. C. Peterson, Difference equations an introduction with applications, 2nd edition, Harcourt Academic Press, USA, 2001.

F. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Introduction and Course Hand-out briefing	Have awareness about course	Lecture	MA1105.1	MTE I ETE
2	Higher trigonometry – Introduction	Understanding the concepts	Lecture	MA1105.1	MTE I ETE
3,4	Basics of Complex numbers	Discuss the basics of complex numbers	Lecture	MA1105.1	MTE I Assignment ETE
5,6	Operations of Complex numbers	Learn the operations	Lecture	MA1105.1	MTE I Assignment ETE
7,8,9	Properties of complex numbers	Understanding the properties	Lecture	MA1105.1	MTE I Assignment ETE
10,11,12	Geometrical Interpretation and representations of complex numbers	Discuss the geometrical interpretation	Lecture	MA1105.1	MTE I Assignment ETE
13,14,15	De Moivre's theorem; Statement and proof	Learn the theorem	Lecture	MA1105.1 MA1105.2	MTE I Assignment ETE
16,17,18	De Moivre's theorem for integral indices	Understating the theorem in different forms	Lecture	MA1105.1 MA1105.2	MTE I Assignment ETE
19,20,21	Alternative method, Proof for rational indices	Discuss the proof of the theorem	Lecture	MA1105.1 MA1105.2	MTE I Assignment ETE
22,23,24	All possible	Learn the	Lecture	MA1105.1	MTE I

	values of $\cos x \pm i \sin x)^{p/q}$	problems related to theorem		MA1105.2	Assignment ETE
25,26	Application of De-Moivre's theorem for integral and fractional indices	Understanding the applications of theorem	Lecture	MA1105.1 MA1105.2	MTE I Assignment ETE
27,28,29	Expansion of sin(nx), cos(nx) in series of sinx, cosx	Learn use of theorem for expansion of sinnx and cosnx	Lecture	MA1105.1 MA1105.2	MTE I Assignment ETE
30	Trigonometric Functions: properties	Understanding the trigono. functions	Lecture	MA1105.3	MTE I
31, 32	Trigonometric Functions: properties-II	Learn the properties	Lecture	MA1105.3	Assignment
33, 34	Trigonometric Functions: Identities	Discuss the different identities of trigo. functions	Lecture	MA1105.3	ETE
35	Trigonometric Functions: Identities-II	Learn to practice problems related to properties	Lecture	MA1105.3	MTE I Assignment ETE
36,37,38	Definitions of logarithmic , Inverse functions	Understating the concept of log and inverse functions	Lecture	MA1105.4	MTE II Assignment ETE
39,40,41	Exponential functions	Learn the exponential functions	Lecture	MA1105.4	MTE II Assignment ETE
42,43,44	Hyperbolic functions	Understand the hyperbolic functions	Lecture	MA1105.5	MTE II Assignment ETE
45,46,47	Laws of logarithm; Summation of series.	Learn the summations of series.	Lecture	MA1105. 5	Assignment ETE
48, 49, 50, 51	Revisions class-1,2,3,4	practice	Lecture	ALL	NA

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I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT							CORRELATION WITH SPECIFIC OUTCOMES			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
[1105. 1]	Solve problems based on complex numbers and employ to use the concepts in the relevant field.	3							3	3	3	
[1105.2]	Learn to apply the De-moivre's theorem in various problems like expansion of sin nx, con nx etc.		2	2					3	3	3	
[1105.3]	Employ the concept of complex number theory to solve problems related to trigonometric functions that will enhance thinking skills.				2	2			3	3	3	
[1105.4]	Solve the mathematical problems related to hyperbolic and exponential functions.						2		3	3	3	
[1105.5]	Use the properties and different standard results of logarithmic functions in their relevant field.			1					3	3	3	

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Computer Applications

Course Handout

FUNDAMENTALS OF COMPUTERS | CA1170 | 2 Credits | **1 1 0 2**

Session: July – December 2020|Faculty: Dr. Vanita Jaitly| Course: B. Sc. (Hons.) Maths I Sem

A. INTRODUCTION

The present era is evolving around computing devices. The one who is lacking the knowledge of computing devices is considered as illiterate. Therefore, this course is targeted to bring awareness and knowledge of various computing devices and accessories. The main objectives of the course are as follows:

- Identify the main system elements of a computer system and describe their function.
- Describe the main hardware components of a Personal Computer.
- Describe the main software elements of a computer system.

B. COURSE OUTCOMES

At the end of the course, students will be able to

[1170.1]. To understand the fundamental concepts of the computer system with the contemporary skill and knowledge.

[1170.2]. To analyse and understand the knowledge of computer equipment both hardware and software, which would leverage the options of employability.

[1170.3]. To describe various operating systems, peripheral devices, networking, multimedia and internet.

[1170.4]. Demonstrate and understand the terms and various functions associated with hardware and software program menus of computer systems, amalgamation of which would help a student in enhancing entrepreneurship skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAM SPECIFIC OUTCOMES

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

D. ASSESSEMENT PLAN

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes	10
End Term Exam (Summative)	End Term Exam (Close Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

E. SYLLABUS

CA1170 FUNDAMENTALS OF COMPUTERS [1 1 0 2]

Computer Fundamentals, Definition and Purpose, Data, Information and Knowledge, Characteristics of Computers, Classification of Computers, Generations of Computer, Basic organization of Computer, System Software and Application Software. Operating Systems and Multimedia, Types of Operating System, Windows v/s Linux, Mobile based OS, Multimedia, Definition and Types , Multimedia Software, Computer Networks, Applications of Networking, Network Topologies- Mesh, Bus, Star, Ring, Types of Network (LAN, MAN, WAN), Network Cables- Optical Fiber, Twisted, Co-axial, Network Devices- Hubs,

Switch, Router, Network Interface Card, Ethernet, Internet, Introduction and Usage of Internet, Internet Connectivity Options (Wired and Wireless), IP Addressing and DNS, Website, URL, HTML, Web Browser and Search Engines, Operational Guideline of Computer Usage, Do's and Don'ts of Computer, E-mails, Email Etiquettes, Cyber Security, Internet Frauds, Secure Password Formation , Computer Security, Malware, Virus, Ransomware, Social Media and its Impact.

TEXT BOOKS

1. E. Balagurusamy "*Fundamentals of Computers*" Published by Tata McGraw-Hill Education Pvt. Ltd.
2. P.K.Sinha*, "Computers Fundamentals",* BPB Publications.

REFERENCE BOOKS

1.R. Thareja, *Fundamental of Computer*, (1e) Oxford Publications, 2014.
2. K. Atul, *Information Technology*, (3e) Tata McGraw Hill Publication, 2008.

F. LECTURE PLAN

Lec. No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1-3	• Definition and Purpose • Data, Information and Knowledge Characteristics of a computer	To acquaint and clear teachers expectations and understand student expectations Basic understanding of computer and its resources. Explain the classification of computers.	Discussion	1170.1	NA
4-6	• Classification of Computers • Generations of Computer • Basic organization of Computer, System Software and Application Software	Describe various generations of computers. Describe various types of networks. Describe types of network cables and their design.	Lecture & Discussion	1170.1	In Class Mid Term I End Term
7-9	• Operating Systems and Multimedia • Types of Operating System • Windows v/s Linux Mobile based OS	Describe various types of operating system. Describe the basic differences between windows and linux operating systems. Explain the mobile based operating systems.	Lecture & Discussion	1170.3	In Class Mid Term I End Term
10-12	• Definition and Types • Multimedia Software	Discuss the Multimedia types and applications	Lecture & Discussion	1170.3	In Class Mid Term I End Term

		Describe multimedia software's and their working			
13-15	• Computer Networks • Applications of Networking • Network Topologies- Mesh, Bus, Star, Ring • Types of Network (LAN, MAN, WAN) • Network Cables- Optical Fiber, Twisted, Co-axial • Network Devices- Hubs, Switch, Router, Network Interface Card	Explain the networking applications. Describe the features of different topologies. Describe various types of networks. Describe types of network cables and their design. Elaborate the Types of network devices. Explain NIC and ethernet.	Lecture & Discussion	1170.3 1170.4	In Class Mid Term I End Term
16-18	• Introduction and Usage of Internet • Internet Connectivity Options (Wired and Wireless) • IP Addressing and DNS, Website, URL, HTML • Web Browser and Search Engines	Explain the internet model and applications of internet. Explain the difference between wired and wireless connections, sbasics of Wifi.	Lecture & Case Study	1170.3	Class Quiz Mid Term I End Term
19-21	• Operational Guideline of Computer Usage • Do's and Don'ts of Computer • e-mails, • email Etiquettes, System Software and Application Software	Explain IP address and DNS. Describe the Functions of Websites, HTML basics. Describe various types of web browsers and search engines. Learn to use computers in a secure and efficient manner. To compose emails and explain the email exchange process.	Lecture & Discussion	1170.3 1170.4	Class Quiz Mid Term I End term
22-24	• Cyber Security • Internet Frauds • Secure Password Formation • Computer Security • Malware, Virus, Ransomware Social Media and its Impact	To understand cyber security, internet attacks. Learn to make strong passwords to improve security concerns. Learn and understand the malwares and types of viruses, difference between malware and virus	Lecture & Practical	1170.1	Class Quiz Mid Term II End Term

G. COURSE ARTICULATION MATRIX: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
CA 1170.1	To understand the fundamental concepts of the computer system with the contemporary skill and knowledge.	**1**					**1**		**1**			
CA 1170.2	To analyse and understand the knowledge of computer equipments both hardware and software, which would leverage the options of employability.		**1**		**1**					**1**		
CA 1170.3	To describe various operating systems, peripheral devices, networking, multimedia and internet.		**1**					**1**	**1**			
CA 1170.4	Demonstrate and understand the terms and various functions associated with hardware and software program menus of computer systems, amalgamation of which would help a student in enhancing entrepreneurship skills.	**1**				**1**	**1**				**1**	

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

Faculty of Science

School of Basic Sciences

Department of Chemistry
Course Hand-out

Environmental Science| CY 1003 | 3 Credits | 3 0 0 3

Session: July – Dec 2020 | Faculty: Dr. M. Prabhu Inbaraj | Class: B.Sc. Hons Mathematics | Semester I

A. **Introduction:** This course is offered by Dept. of Chemistry as a Compulsory Course, targeting students who are studying in undergraduate courses of higher education of all branches including Science, Arts, Social Sciences, Design, Business and Commerce, Journalism and Mass Communication. Offers the knowledge of how natural world works, Environmental and natural processes which effects humans and how human activities and developmental processes change the environment and natural systems. Conservation of nature and natural resources, ecosystems and their services, biodiversity loss and its conservation, environmental pollution, effects and control, environmental policies and practices, human communities and the environment. Students are expected to have basic knowledge of science and social sciences for a better learning.

B. **Course Outcomes:** At the end of the course, students will be able to

[1003.1] Acquire awareness and sensitivity to environmental and its allied problems.

[1003.2] Acquire enhanced skills for identifying and solving environmental problems to gain employability.

[1003.3] Find out the environmental problems concerning with human activities and developmental processes.

[1003.4] Understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.

[1003.5] Understand physical and chemical processes required for environmental sustainability.

[1003.6] Understand chemical processes for waste management and environmental conservation.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
[PO2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

INTRODUCTION Multidisciplinary Nature of Environmental Studies, Scope and importance, concept of sustainability and sustainable development **ECOSYSTEMS** Concept, structure and function, energy flow in an ecosystem, food chain, food webs and ecological succession, examples. **NATURAL RESOURCES (RENEWABLE & NON RENEWABLE RESOURCES)** Land Resources and land use change, Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies **BIODIVERSITY AND CONSERVATION** Levels, Biogeographic zones ,Biodiversity patterns and hot spots, India as a mega-biodiversity nation; Endangered and endemic species, threats, conservation, biodiversity services **ENVIRONMENTAL POLLUTION** type, causes, effects, and controls of Air, Water, Soil and Noise pollution, Nuclear hazards and human health risks, ill effects of fireworks, Solid waste management, case studies **ENVIRONMENTAL POLICIES & PRACTICES** Climate change, global warming, ozone layer depletion, acid rain, Environment laws, International agreements, nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context **HUMAN COMMUNITIES AND THE ENVIRONMENT** Human population growth, human health and welfare, Resettlement and rehabilitation, case studies, Disaster management, Environmental ethics, Environmental communication and public awareness, case studies, Field work and visit.

F. TEXT BOOKS

T1. Rajagopalan, R., Environmental Studies: From Crisis to Cure, Oxford University Press, 2016.

T2. De, A. K. *Environmental Studies*, New Age International Publishers, New Delhi, 2007.

T3. Bharucha, E., *Text book of Environmental Studies for undergraduate courses*, Universities Press, Hyderabad, 2nd Edition, 2013.

G. REFERENCE BOOKS

R1. Gadgil, M., & Guha, R. *This Fissured Land: An Ecological History of India*. Univ. of California, Press, 1993.

R2. Carson, R. *Silent Spring*. Houghton Mifflin Harcourt, 2002.

R3. Groom, Martha J., Gary, K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.

R4. Singh, J.S., Singh, S.P., Gupta, S.R. Ecology, Environmental Science and conservation. S. Chand Publishing, New Delhi, 2014.

R5. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). *Conservation Biology: Voices from the Tropics. John Wiley & Sons,* 2013.

H. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Introduction to Environmental Studies: multidisciplinary nature of environmental studies	Explain about environment and its processes and to interpret as multidisciplinary subject	Lecture	1003.1	In Class Quiz Mid Term I End Term
2	Scope and importance, concept of sustainability and sustainable development	Recall concept of sustainability, Explain sustainable development, Scope and importance of environmental science	Lecture	1003.1	Mid Term I End Term
3,4	Ecosystem: concept, structure and function, Energy flow in an ecosystem, food chain, food webs	Explain ecosystem with structure, flow of energy, nutrients cycling in the ecosystem, food chain and food webs	Lecture	1003.1	In Class Quiz Mid Term I End Term
5,6	Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem (Ponds, Streams, Lakes, River, Oceans, Estuaries)	Explain different type ecosystem with examples of terrestrial and aquatic ecosystem and their importance	Lecture	1003.1	In Class Quiz Mid Term I End Term
7.8	Ecological succession, Natural Resources	Recall Ecological succession and its type,	Lecture	1003.1	In Class Quiz Mid Term I

	(Renewable & Non Renewable Resources): Land Resources and land use change, Land degradation	Explain different Natural Resources including Land Resources and land use change			End Term
9	Soil erosion and desertification	Recall soil degradation by erosion and desertification	Lecture	1003.2	Mid Term I End Term
10	Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations	Recall Deforestation processes and their impact on the environment and biodiversity	Lecture	1003.2	Mid Term I End Term
11	Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).	Recall distribution and consumption pattern of water across the world and its related environmental issues including overexploitation and conflicts	Lecture	1003.2	Mid Term I End Term
12	Energy resources: Renewable and Non-renewable energy sources	Recall different Energy resources including coal, oil, nuclear and their environmental impacts on the environment and on human health	Lecture	1003.2	Mid Term I End Term
13	Use of alternate energy sources	Explain other energy resources including solar, water, wind, geothermal and hydrogen energy for sustainability.	Lecture	1003.2	Mid Term I End Term
14	Growing energy needs, case studies	Recall energy demand and supply in different sector and their environmental concern	Lecture	1003.2	Mid Term I End Term
15,16	Biodiversity and conservation: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India	Recall different variety and variability of plants and animals Explain different type of biodiversity and Biogeographic zones of India	Lecture	1003.3	Mid Term II End Term
17	Biodiversity patterns and global biodiversity hot spots	Compare biodiversity at national and global level and ecological hotspots for their respective biodiversity	Lecture	1003.3	Mid Term II End Term
18	India as a mega-biodiversity nation; Endangered and endemic species of India	Recall different mega-diversity nation including India	Lecture	1003.3	Mid Term II End Term

		Describe different Endangered and endemic species of India			
19	Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions	Explain biodiversity loss and their reasons, Explain biological invasive species and their impact on biodiversity	Lecture	1120.3	Mid Term II End Term
20	Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value	Explain the goods and services provided by biodiversity and the ecosystem	Lecture	1003.4	Mid Term II End Term
21	Conservation of biodiversity: *In-situ* and *Ex-situ*	Explain different measures of conservation of biodiversity, Description of National parks, wildlife sanctuaries etc.	Lecture	1003.4	Mid Term II End Term
22	Environmental pollution: type, causes, effects, and controls of Air Pollution	Recall air pollution and their effects and explain different air pollutants and their impacts on environment and human health	Lecture	1003.5	Mid Term II End Term
23	ill effects of fireworks , Controls of Air Pollution	Describe harmful impact of fireworks and control methods of air pollutants like ESP, Scrubber	Lecture	1003.5	Mid Term II End Term
24	Type, causes, effects of Water Pollution	Describe water pollutants and their effects, BOD, COD, water quality parameters, DO, TSS	Lecture	1003.5	Mid Term II End Term
25	Controls of Water Pollution	Describe conventional and advance methods for prevention and control of water pollution	Lecture	1003.5	Mid Term II End Term
26	Causes, effects of Soil and Noise Pollution, Nuclear hazards and human health risks	Explain the Causes, effects of Soil and Noise Pollution, Nuclear hazards and human health risks	Lecture	1003.5	Mid Term II End Term
27	Solid waste management: control measures of urban and industrial waste	Describe different type of solid waste and their methods of management	Lecture	1003.5	Mid Term II End Term
28,29	Pollution case studies, Environmental Policies & Practices: Climate change and global warming,	Recall of environmental pollution with some case studies, Describe sources and effects of greenhouse gases in	Lecture	1003.6	Mid Term II End Term

	International agreements: Kyoto protocols and Convention on Biological Diversity (CBD)	global warming and climate change and their environmental impact, Explain different treaties for reduction of greenhouse gases and conservation of biodiversity			
30,31	Ozone layer depletion, Montreal protocols, Acid rain and impacts on human communities and agriculture	Explain the importance of ozone layer and causes of its depletion, control measures, Describe the Acid Rain with its effects and control	Lecture	1003.6	End Term
32,33	Environment laws; Water (Prevention and control of Pollution) Act, Air (Prevention and Control of Pollution) Act, Environmental Protection Act,	Describe the provision of Water Act, 1974, Air Act, 1981for prevention and control of water and air pollution, Explain EPA, 1986	Lecture	1003.6	End Term
34,35	Wildlife Protection Act, Forest Conservation Act; Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context, Human communities and the Environment: Human population growth: impact on environment	Describe the provision of Wildlife Protection Act, Forest Conservation Act, Explain Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context, impact of population growth on environment	Lecture	1003.6	End Term
36, 37	Human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management: flood, earthquake, cyclone and landslides	Explain human health with respect to environment, measures of disaster management, Describe natural disasters and their impact	Lecture	1003.6	End Term
38	Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan,	Describe different movement in Indian continents for conserve environment and their socio-economic importance	Lecture	1003.6	End Term
39, 40	Environmental ethics: Role of Indian and other religions and cultures in environmental	Describe role of ethics in preservation and conservation of environment, environmental	Lecture	1003.6	End Term

	conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Revision on Ecosystem and Natural Resources	awareness programme, green enrgy concept and revision			
41-42	Revision on Biodiversity & Conservation, Environment Pollution and Environmental Policies	Revision for preparation for end term exam	Lecture	1003.6	Class quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O1	PS O2	PS O3	PS O4
CY 1003.1	Acquire awareness and sensitivity to environmental and its allied problems.		1	3			3	2	1	1	1	
CY 1003.2	] Acquire enhanced skills for identifying and solving environmental problems to gain employability	2		1	1	2	3	2			2	
CY 1003.3	Find out the environmental problems concerning with human activities and developmental processes.		1	2	2		3		2	2		
CY 1003.4	Understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.	3				2	3	3	1	1	1	
CY 1003.5	Understand physical and chemical processes required for environmental sustainability.	3	2	1	1	3	3	2	3	3	1	
CY 1003.6	Understand chemical processes for waste management and environmental conservation.	2	1	2	1	3	3	2	3	1	2	

1 - Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Humanities and Social Sciences

DEPARTMENT OF LANGUAGES

Course Hand-out

Communicative English | LN1106 | 2 Credits | 2002

Session: July20 –Dec 20 | Faculty: Dr Deepa Sarabhai | Class: BSc I SEM

A. Course Perspective: This course is offered by Department of Languages as a common course to the students of Semester-I of non-Engineering disciplines. The course offers an in-depth knowledge of language as an important branch of English language studies. It covers basic concepts such as role of communication, word formation, English Grammar, comprehension, composition. It also focuses on the enhancement of the LSRW skills.

B. Course Objectives:

LN1106.CO.1 Enhance the learner's communication skills by giving adequate exposure to LSRW skills
LN1106.CO. 2 Recognize and overcome learner's shortcomings in pronunciation and grammar
LN1106.CO. 3 Enrich the vocabulary with advanced readings
LN1106.CO. 4 Impart better writing skills by sensitizing the learners to the dynamics of effective writing
LN1106.CO.5 Build up learners' confidence in oral and interpersonal communication specially focusing on interviews

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking:** Explore and explain the substantial & procedural laws in which they are made/drafted and how students think and understand the legislative setup.

[PO.2]. **Effective Communication:** After completion of the programme student will be able to learn the art of communicating and demonstrating their oral advocacy skills. Projecting the facts in a way suitable to the client and power to convince on legal reasoning forms the essence of communication in courts of law.

[PO.3]. **Social Interaction:** Ability of the students to analyze the legal and social problems and work towards finding solutions to the problems by application of laws and regulations.

[PO.4]. **Effective Citizenship:** Inculcate values of Rights and Duties, and transfer these values to real-life through legal and judicial process for promoting community welfare.

[PO.5]. **Ethics:** Apply ethical principles and commit to legal professional ethics, responsibilities and norms of the established legal practices.

[PO.6]. **Environment and Sustainability:** Understand the impact of the professional, legal solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

[PO.7]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broader context of legal change.

[PSO.1] To understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2] To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

[PSO.3] To develop creative thinking and the power of imagination

[PSO.4] To expose the graduates in research in academia and industry for broader applications

D. Pedagogy. The pedagogy would be the combination of the following techniques:-

- Lectures
- Presentations
- Classroom activities
- Discussions, Questions & Answers
- Case Study

E. Learning Outcomes: By the end of this course, students will be able to:

1. Understand the fundamental principles of effective communication and presentation skills
2. Develop critical and creative thinking abilities for communicative competence
3. Display enhanced competence in oral and written communication
4. Improve ideas with precision and coherence in LSRW skills
5. Recognize the importance of grammar in written communication

F. Evaluation:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	Class Quizes, Assignments, Activities, etc.	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work at home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

G. Course Outline/ Syllabus

Communication- Definition, Process, Types, Flow, Modes, Barriers; Types of Sentences; Modal Auxiliaries; Tenses and its Usage; Voice; Reported Speech; Articles; Subject-Verb Agreement; Spotting Errors; Synonyms and Antonyms; One Word Substitution; Reading Comprehension; Précis Writing; Essay Writing; Formal Letter Writing; Email Etiquettes; Résumé & Curriculum Vitae; Statement of Purpose; Presentations

H. References:

1. *Collins English Usage*. Harpers Collins, 2012.
2. Hobson, Archie Ed. *The Oxford Dictionary of Difficult Words.* Oxford, 2004.
3. Jones, Daniel. *English Pronouncing Dictionary*. ELBS, 2011.
4. Krishnaswamy, N. *Modern English: A Book of Grammar Usage and Composition*, Macmillan India, 2015.
5. *Longman Dictionary of Contemporary English.* Pearson, 2008.
6. McCarthy, M. *English Idioms in Use*. Cambridge UP, 2002.
7. Mishra, S. and C. Muralikrishna. *Communication Skills for Engineers*. Pearson, 2004.
8. *Oxford Dictionary of English*. Oxford UP, 2012.
9. Turton, N. D. and J.B. Heaton. *Longman Dictionary of Common Errors*. Pearson, 2004.

I. Lecture Plan:

L No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to the Course and topics		Lecture/ Discussion	NA	NA
2	Communication- Definition, Process,	Understand the fundamental principles of effective communication and presentation skills	Lecture/ Discussion	LN1106.1	Quiz/Mid term I/ ET
3	Types, Flow, Modes	Understand the fundamental principles of effective communication and presentation skills	Lecture/ Discussion	LN1106.1	Quiz/Mid term I/ ET
4	Barriers	Understand the fundamental principles of effective communication and presentation skills	Lecture/ Discussion	LN1106.1	Quiz/Mid term I/ ET
5	Types of Sentences	Develop critical and creative thinking abilities for communicative competence	Lecture/ Discussion	LN1106.2	Quiz/Mid term I/ ET

6	Modal Auxiliaries	Develop critical and creative thinking abilities for communicative competence	Lecture/ Discussion	LN1106.2	Quiz/Mid term I/ ET
7	Tenses and its Usage	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/Mid term I/ ET
8	Tenses and its Usage	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/Mid term I/ ET
9	Voice	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/ Mid term II/ET
10	Voice	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/ Mid Term II/ ET
11	Reported Speech	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/ Mid Term II/ ET
12	Reported speech	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/ Mid Term II/ ET
13	Articles	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.2	Quiz/ Mid Term II/ ET
14	Subject-Verb Agreement	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/ Mid Term II/ ET
15	Subject-Verb Agreement	Recognize the importance of grammar in written communication	Lecture/ Discussion	LN1106.2	Quiz/ Mid Term II/ ET
16	Spotting Errors	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.2	Quiz/ Mid term II/ET
17	Spotting Errors	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1	Quiz/ ET
18	Synonyms and Antonyms	Improve ideas with precision and	Lecture/ Discussion	LN1106.1/ LN1106.3	Quiz/ ET

		coherence in LSRW skills			
19	One Word Substitution	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.3	Quiz/ ET
20	Reading Comprehension	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1	Quiz/ ET
21	Précis Writing	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.4	Quiz/ ET
22	Essay Writing	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.4	Quiz/ ET
23	Formal Letter Writing	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.4	Quiz/ ET
24	Email Etiquettes	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.4	Quiz/ ET
25	Résumé & Curriculum Vitae	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.4	Quiz/ ET
26	Statement of Purpose	Improve ideas with precision and coherence in LSRW skills	Lecture/ Discussion	LN1106.1/ LN1106.4	Quiz/ ET
27	Presentation	Display enhanced competence in oral and written communication	Presentations	LN1106.5	GD
28	Presentation	Display enhanced competence in oral and written communication	Presentations	LN1106.5	GD

J. Alignment of Assessment tools to COs

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT		Correlation with Program Outcomes (POs) and Program Specific Outcomes (PSOs)									
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**
LN1106. CO.1	Enhance the learner's communication skills by giving adequate exposure to LSRW skills		**3**	**2**	**1**	**1**	**1**	**3**		**2**		
LN1106. CO.2	Recognize and overcome learner's shortcomings in pronunciation and grammar		**2**	**1**				**1**				
LN1106. CO.3	Enrich the vocabulary with advanced readings		**2**	**1**				**1**				
LN1106. CO.4	Impart better writing skills by sensitizing the learners to the dynamics of effective writing		**2**	**1**		**1**	**1**	**2**		**2**		
LN1106. CO.5	Build up learners' confidence in oral and interpersonal communication specially focusing on interviews		**3**	**2**	**1**	**2**	**1**	**3**		**1**		

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

K. Expectations from Students:

1. Shall read the topics in advance before coming to the class
2. Shall participate in discussions
3. Shall be regular in the class (75% attendance)
4. Shall complete all the assignments in time
5. Shall be punctual in class
6. Classroom doors shall be closed after 5 min. of the start of the class.

L. Attendance:

A student with less than 75% attendance in this course will not be permitted to write the End Term Examination and will be awarded DT (Detained) letter grade.

M. Faculty Details and meeting timings:

Dr. Deepa Sarabhai

Contact Hours: Monday to Saturday, Time: 1600 hrs to 1700 hrs

Email ID: deepa.sarabhai@jaipur.manipal.edu

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics and Statistics
Course Hand-out

Descriptive Statistics| MA1140 | 3 Credits | 2 1 0 3

Session: July – Dec 2020 | Faculty: Dr. Bhoopendra Pachauri [MU - Jaipur]

A. **Introduction:** This course is offered by Dept. of Mathematics and Statistics, targeting that the students who wish to pursue the empirical research based on the data set. Offers in depth knowledge of collecting, organizing, presenting and summarizing the qualitative and quantitative data and it gives the knowledge of nature of data, properties of distribution, descriptive statistical tools, central tendency, dispersion, moments, skewness and kurtosis, theory of attributes, that can be used to draw conclusions about the data.

B. **Course Outcomes:** At the end of the course, students will be able to

[1140.1]. collect appropriate data from the field for the empirical study.

[1140.2]. completely describe a data set using appropriate descriptive statistics.

[1140.3]. demonstrate knowledge of, and applications of, appropriate descriptive statistical tools to the data set.

[1140.4]. construct and analyze graphical displays to summarize data and enhance managerial skills to increase employability.

[1140.5]. interpret a set of descriptive statistics results and understand the limitations of each measure.

[1140.6]. utilize a comprehensive set of descriptive statistical methods, using calculator and statistical software, in order to organize, summarize, and display data in a meaningful way.

C. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Introduction of Statistics: Definition, scope, uses and limitations;

Types of Data: Qualitative and quantitative data, nominal and ordinal data, time series data, discrete and continuous data, frequency and non-frequency data;

Collection of Data: Collection of primary and secondary data- its major sources, classification and tabulation of data; **Presentation of Data:** Frequency distribution and cumulative frequency distribution, diagrammatic and graphical presentation of data, construction of bar, pie diagram, histogram, frequency polygon, frequency curve and ogives; **Measures of Central Tendency and Location:** Arithmetic mean, median, mode, geometric mean, harmonic mean, partition values-quartiles, deciles, percentiles and their graphical location along with their properties, applications, merits and demerits;

Measures of Dispersion: Characteristics for an ideal measure of dispersion, absolute and relative measures of dispersion, range, inter quartile range, quartile deviation, coefficient of quartile deviation, mean deviation, coefficient of mean deviation, standard deviation, coefficient of variation and properties of these measures;

Moments, Skewness and Kurtosis: Moments about mean and about any point and their relationship, effect of change of origin and scale, Sheppard's correction for moments (without derivation), Charlier's checks, coefficients of skewness and kurtosis with their interpretations;

Bivariate Data: Scatter diagram, correlation, product moment correlation coefficient and their uses, rank correlation, concept of multiple correlation and partial correlation in case of three variables, regression analysis.

F. TEXT BOOKS

1. Gupta, S.C. and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Co., 3rd edition, New Delhi, 2008.
2. Gupta, S.C., Statistical Methods, Sultan Chand & Sons., New Delhi 2012.
3. Rohatgi, V.K., An introduction to Mathematical Statistics, John Wiley & Sons, 1976.

G. REFERENCE BOOKS

1. Goon, A.M., Gupta M.K., Dasgupta, B., Fundamental of Statistics, Vol. I, World Press, 1975.
2. Yule, G.V. and Kendall, M.G., Introduction to Theory of Statistics, C. Griffin, 1976.
3. Kenny, J.F. and Keeping, E.S., Mathematics of Statistics, Vol. I, Chapman-Mall Ltd, London 1954.

H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to Statistics: Definition, Scopes, uses and limitations	Understand the importance of statistics	Lecture	1140.1	Home Assignment Class Quiz Mid Term I End Term
2,3	Types of data: Qualitative and quantitative data, nominal and ordinal data, time series data, discrete and continuous data, frequency and non-frequency data	Understand the nature of data	Lecture	1140.1	Home Assignment Class Quiz Mid Term I End Term
4,5	Collection of data: collection of primary and secondary data –its major sources, classification and tabulation of data	Can collect the data from different sources	Lecture	1140.1	In Class Quiz Mid Term I End Term
6,7	Presentation of data: frequency distribution and cumulative frequency distribution	Can present the data using frequency distribution	Lecture	1140.1	In Class Quiz Mid Term I End Term
8,9	Diagrammatic representation of data	Represent data diagrammatic	Lecture	1140.2	Class Quiz Mid Term I End Term
10, 11	Graphical representation of data	Represent data graphical	Lecture	1140.2	Class Quiz Mid Term I End term
12	Measures of central tendency and location: Arithmetic mean its properties, applications and its merits and demerits	**Can identify the central value of data**	Lecture	1140.2	Class Quiz Mid Term I End Term
13,14	Geometric mean and Harmonic mean their properties, applications	**Can identify the central value of data**	Lecture	1140.2	Class Quiz Mid Term I End Term

	and their merits and demerits				
15,16	Median its properties, applications and its merits and demerits	**Can identify the central value of data**	Lecture	1140.2	Class Quiz Mid Term I End Term
17,18	Mode its properties, applications and its merits and demerits	**Can identify the central value of data**	Lecture, Activity	1140.2	Class Quiz End Term Mid Term I
19,20	Partition values- quartiles, deciles, percentiles and their graphical location along with their properties, applications and their merits and demerits	**Can identify the central value of data**	Lecture	1140.3	Class Quiz End Term Mid Term I
21,22	**Measures of dispersion**: Characteristics for an ideal measure of dispersion, absolute and relative measure of dispersion, range, coefficient of range, properties of range	**Can measure the variation in data**	Lecture	1140.3	Class Quiz Mid Term II End Term
23,24	Inter quartile range, quartile deviation, coefficient of quartile deviation and properties	**Can measure the variation in data**	Lecture	1140.3	Class Quiz Mid Term II End Term
25,26	Mean deviation, coefficient of mean deviation and properties	**Can measure the variation in data**	Lecture	1140.3	Class Quiz Mid Term II End Term
27,28	Standard deviation, coefficient of standard deviation and properties	**Can measure the variation in data**	Lecture	1140.3	Class Quiz Mid Term II End Term
29	**Moments, Skewness and Kurtosis**: moments about mean, moments about any point and their relationship	Measure the nature and shape of data	Lecture	1140.4	Class Quiz Mid Term II End Term
30	Effect of change of origin and scale, Sheppard's correction for moments	Measure the nature and shape of data	Lecture	1140.4	Class Quiz Mid Term II End Term
31	Charlier's checks	Measure the nature and shape of data	Lecture	1140.4	Class Quiz Mid Term II End Term
32	Coefficient of skewness and Kurtosis with their interpretations	Measure the nature and shape of data	Lecture	1140.5	Class Quiz Mid Term II End Term
33,34, 35,36	**Bivariate Data:** Scatter diagram, correlation, product moment correlation coefficient and their uses, rank correlation, concept of multiple correlation and partial correlation in case of three variables, regression analysis.	**Become able to find relationship and predict the future values**	Lecture	1140.6	Class Quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
1140.1	collect appropriate data from the field for the empirical study	**2**	**2**	**1**	**2**	**1**			**2**		**2**	**3**
1140.2	completely describe a data set using appropriate descriptive statistics	**2**	**3**		**3**				**3**	**2**	**2**	**3**
1140.3	demonstrate knowledge of, and applications of, appropriate descriptive statistical tools to the data set.	2	**3**	**2**	**3**				**2**	**3**	**3**	**2**
1140.4	construct and analyze graphical displays to summarize data and enhance managerial skills to increase employability	**1**	**3**		**2**				**2**		**3**	**2**
1140.5	interpret a set of descriptive statistics results and understand the limitations of each measure.	**2**	**3**		**3**				**1**		**3**	**3**
1140.6	utilize a comprehensive set of descriptive statistical methods, using calculator and statistical software, in order to organize, summarize, and display data in a meaningful way.	**2**	**3**		**2**						**2**	**3**

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences
Department of Mathematics & Statistics
Course Hand – Out
Differential Equations – MA1203 Credits| 3 1 0 4
Session: Jan-May 2020 | Faculty: Dr. Indeewar Kumar| Class: BSc (Hons) Mathematics II Sem

A. Introduction:-

A differential equation is an equation for a function that relates the values of the function to the values of its derivatives. An ordinary differential equation (ODE) is a differential equation for a function of a single variable, e.g., x(t), and higher order linear differential equations while a partial differential equation (PDE) is a differential equation for a function of several variables, e.g., v(x, y, z, t). An ODE contains ordinary derivatives and a PDE contains partial derivatives.

B. **Course Outcomes**: At the end of the course, students will be able to

[MA1203.1] Describe the concept of ordinary differential equations and enhance the skill to solve the problem

[MA1203.2] Understand conceptual framework of nonlinear differential equation and enhance the knowledge

[MA1203.3] Describe the concept of Higher order linear differential equations and develop the skill to solve the problem

[MA1203.4] Describe the concept of Partial differential equations and its problem

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1] To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2] To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3] To develop creative thinking and the power of imagination
[PSO.4] To expose the graduates in research in academia and industry for broader applications

D. **Assessment Plan:-**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Close Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who missed the classes or getting lass marks, the remedy classes has to be taken.	
Homework/ Home Assignment/ Activity Assignment (Formative)	Student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. **SYLLABUS**

Ordinary Differential Equations: Introduction, order and degree of a differential equation, formation of differential equations, general, particular and singular solution, Wronskian, its properties and applications; Equations of First Order and First Degree: Separation of variables method, homogeneous equations, equations reducible to homogeneous form, linear equations and equations reducible to linear form, exact equations, equations reducible to exact form, orthogonal trajectories in Cartesian coordinates, applications of first order equations; Equations of First Order and Higher Degree: Equations solvable for x, y and p, Clairaut's and Lagrange's equation, equations reducible to Claret's form, Singular solution; Higher Order Linear Differential Equations: Higher order linear differential equations with constant coefficients and variable coefficients, simultaneous ordinary differential equations; Partial Differential Equations: definition, order and degree, formation of partial differential equations, Lagrange's method of solution, standard forms, Charpit Method.

References:

1. J. L. Bansal, S. L. Bhargava and S. M. Agarwal, Differential Equations, Jaipur Publishing House, Jaipur, 2012.
2. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Comp., New Delhi, 2013.

3. S. L. Ross, Differential Equations, Wiley India, New Delhi, 2013.
4. E.A. Coddington, An Introduction to Ordinary Differential Equations, PHI Publication, New Delhi, 2011.
5. R. K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, 4th edition, Narosa Publishing House, 2014.
6. G. F. Simmons, Differential Equations, Tata McGraw-Hill, 2006.

H. **Lecture Plan**: -

Lecture No.	TOPICS	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Ordinary Differential Equations	Introduction ODE	Lecture	MA1203.1	Home Assignment and Class Quiz Mid-Term I End-Term
2 ,3	Formation of differential equations	Formation of ODE	Lecture	MA1203.1	Home Assignment and Class Quiz Mid-Term I End-Term
4,5	General, particular and singular solution, Wronskian, its properties and applications;	Technique of finding CF and PI	Lecture	MA1203.1	Home Assignment and Class Quiz Mid-Term I End-Term
6	Tutorial Class	Technique of finding CF and PI	Lecture	MA1203.1	Home Assignment and Class Quiz Mid-Term I End-Term
	Assignment-I				
7,8	Equations of first order and first degree: Separation of variables method,	Introduction of equations of first order and first degree	Lecture	MA1203.1	Home Assignment and Class Quiz Mid-Term I End-Term
9,10	Tutorial Class	Introduction of equations of first order and first degree	Lecture	MA1203.1	Home Assignment and Class Quiz Mid-Term I End-Term
	Assignment-II				
11,12	Homogeneous equations, equations reducible to homogeneous form,	Introduction and technique to solve	Lecture	MA1203.1 MA1203.2	Home Assignment and Class Quiz Mid-Term I End-Term
13	Tutorial Class	Introduction and technique to solve	Lecture	MA1203.1 MA1203.2	Home Assignment and Class Quiz Mid-Term I End-Term
14,15	Linear equations and equations reducible to linear form,	Introduction and technique to solve	Lecture	MA1203.2	Home Assignment and Class Quiz Mid-Term I End-Term

16,17	Exact equations, equations reducible to exact form	Introduction and technique to solve	Lecture	MA1203.2	Home Assignment and Class Quiz Mid-Term I End-Term
18,19,20	Orthogonal trajectories in Cartesian coordinates, applications of first order equations;	Introduction and technique to solve	Lecture	MA1203.2 MA1203.3	Home Assignment and Class Quiz Mid-Term I End-Term
21	Tutorial Class	Introduction and technique to solve	Lecture	MA1203.2	Home Assignment and Class Quiz Mid-Term I End-Term
	First Sessional				
22,23	Equations of first order and higher degree:	Introduction of first order and higher degree equations	Lecture	MA1203.2 MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
24	Tutorial Class	Introduction of first order and higher degree equations	Lecture	MA1203.2 MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
	Assignment-III				
25,26	Equations solvable for x, y and p, Clairaut's and Lagrange's equation,	Introduction and technique to solve	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
27,28	equations reducible to Claret's form, Singular solution;	Introduction and technique to solve	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
29	Tutorial Class	Introduction and technique to solve	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
30,31	Higher order linear differential equations:	Introduction of higher order linear differential equations	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
32,33	Higher order linear differential equations with constant coefficients	Introduction and technique to solve the problem	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
34	Tutorial Class	Introduction and technique to solve the problem	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
	Assignment-IV				
35,36	and variable coefficients,	Introduction and technique to solve the problem	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term

37,38	simultaneous ordinary differential equations;	Introduction and technique to solve the problem	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
39	Tutorial Class	Introduction and technique to solve the problem	Lecture	MA1203.3	Home Assignment and Class Quiz Mid-Term II End-Term
40,41	Partial Differential Equations: definition, order and degree,	Introduction PDE	Lecture	MA1203.4	Home Assignment and Class Quiz Mid-Term II End-Term
42	Tutorial Class	Introduction to PDE and technique to solve the problem	Lecture	MA1203.4	Home Assignment and Class Quiz Mid-Term II End-Term
	Second Sessional				
43,44	formation of partial differential equations,	Introduction to PDE and technique to solve the problem	Lecture	MA1203.4	Home Assignment and Class Quiz Mid-Term II End-Term
45,46	Lagrange's method of solution,	Introduction and technique to solve the problem	Lecture	MA1203.4	Home Assignment and Class Quiz Mid-Term II End-Term
47,48	standard forms, Charpit Method	Introduction and technique to solve the problem	Lecture	MA1203.4	Home Assignment and Class Quiz Mid-Term II End-Term
49	Tutorial Class	Introduction and technique to solve the problem	Lecture	MA1203.4	Home Assignment and Class Quiz Mid-Term II End-Term
`	Assignment-V				

I. **Course Articulation Matrix: (Mapping of COs with POs and PSOs):-**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME					CORRELATION WITH PROGRAM SPECIFIC OUTCOME					
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA1203.1	Describe the concept of ordinary differential equations and enhance the skill to solve the problem	2	2	1	2				2	3		
MA1203.2	Understand conceptual framework of nonlinear differential equation and enhance the knowledge	1	2			2	2			3	2	
MA1203.3	Describe the concept of Higher order linear differential equations and develop the skill to solve the problem	1	2	2		2			2		2	3
MA1203.4	Describe the concept of Partial differential equations and its problem	1	1	2	2			2		1	2	3

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Science

Department of Mathematics & Statistics
Course Hand-out

Number Theory | MA 1204 | 4 Credits | 3 1 0 4

Session: January – May 2020 | Faculty: Dr. Mahesh Kumar Dubey | Class: B.Sc. (Hons) Mathematics II SEM

A. **Introduction:** This course is offered by Department of Mathematics and Statistics for B.Sc. (Hons.) Mathematics students, targeting students who wish to pursue research & development in industries or higher studies in field of Mathematics and Engineering. Topics discussed include divisibility, the greatest common divisor and least common multiple, prime numbers and their properties, the unique factorization theorem, basic properties of congruences, linear congruences and linear Diophantine equations, the Chinese Remainder Theorem, applications of congruences, the theorems of Fermat, Euler and Wilson, arithmetic functions and their properties, quadratic congruences, quadratic residues and the Quadratic reciprocity law, and primitive roots. Students will able to apply some basic techniques of number theory for the representation of integers.

B. **Course Outcomes:** At the end of the course, students will be able to

[MA 1204.1] Enhanced the logical and analytical skills in the basic concepts of number theory.

[MA 1204.2] Describe the concepts of number theoretic functions and their properties.

[MA 1204.3] Describe the concept of conjectures and their formation about the integers.

[MA 1204.4] Describe the concept of Diophantine equations & Fermat's equation, their simplification which enhance the problem-solving skills.

[MA 1204.5] Describe the concept of primitive roots and quadratic reciprocity law and properties.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

The PSO's of B.Sc. in Mathematics programme are:

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Linear Diophantine equation, prime counting function, statement of prime number theorem, Goldbach conjecture, linear congruence's, complete set of residues, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem, number theoretic functions, sum and number of divisors, totally multiplicative functions, definition and properties of the Dirichlet's product, the Mobius inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function. Order of an integer modulo n, primitive roots for primes, composite numbers having primitive roots, Euler's criterion, the Legendre symbol and its properties, quadratic reciprocity, quadratic congruence's with composite moduli. Public key encryption, RSA encryption and decryption, the equation $x^2 + y^2 = z^2$, Fermat's Last Theorem

F. REFERENCE BOOKS

Text Books:

1. Shirali and Yog, *Number Theory*, Orient Blackswan Private Limited - New Delhi, 2003
2. Neville Robinns, *Beginning Number Theory*, 2nd Edition, Narosa Publishing House Pvt. Limited, Delhi, 2007.

Reference Books

1 David M. Burton, *Elementary Number Theory*, 6th Edition, Tata McGraw-Hil, Indian reprint, 2007.
2 George E. Andrew, *Number Theory*, Revised ed. Edition, Dover Publications; Revised ed., 1994

G. Lecture Plan:

Lecture No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers' expectations and understand student expectations	Lecture Interaction	--	N/A
2	Algebraic operations with integers; Division algorithm	the fundamental operations on integers	Lecture	CO 1	Class Quiz Home Assignment
3	Well ordering principle and mathematical induction	Construct mathematical proofs of statements	Lecture	CO 1	Class Quiz Home Assignment
4	Binary and decimal representation of integers	Concept of binary digits and its applications	Lecture	CO 1	Class Quiz Home Assignment
5	Lame's theorem	Application of Fibonacci number	Lecture	CO 1, 5	Class Quiz Home Assignment
6	Problem solving	Problem solving technique	Tutorial	CO 1, 5	Class Quiz Home Assignment
7	Prime numbers:	To explore various important classes of positive integers	Lecture	CO 2	Class Quiz Home Assignment
8	Fundamental theorem of arithmetic	To know how to factorize any positive integer	Lecture	CO 2	Class Quiz Home Assignment
9	Prime counting function	To explore various important classes of positive integers	Lecture	CO 2	Class Quiz Home Assignment
10	Statement of prime number theorem	To explore various important	Lecture	CO 2	Class Quiz Home Assignment

		classes of positive integers			
11	Sieve of Eratosthenes, Goldbach conjecture	To explore various important classes of positive integers	Lecture	CO 1,2	Class Quiz Home Assignment
12	Problem solving	Problem solving technique	Tutorial	CO 1,2	Class Quiz Home Assignment
13	Linear congruence	Familiar with congruence	Lecture	CO 2	Class Quiz Home Assignment
14	Complete set of residues	Deals with problems of residue	Lecture	CO 2	Class Quiz Home Assignment
15	Chinese remainder theorem	Understand the basic theorem and its application	Lecture	CO 2, 5	Class Quiz Home Assignment
16	Polynomial congruence	Deals with problems of residue	Lecture	CO 2	Class Quiz Home Assignment
17	Fermat's little theorem; Fermat-Kraitchik factorization method	Concept of theorems and its uses	Lecture	CO 2,5	Class Quiz Home Assignment
18	Pseudo primes	Concept of theorems and its uses	Lecture	CO 2	Class Quiz Home Assignment
19	Wilson's theorem	Concept of theorems and its uses	Lecture	CO 2	Class Quiz Home Assignment
20	Euler's theorem	Concept of theorems and its uses	Lecture	CO 2	Class Quiz Home Assignment
21	Problem Solving	Concept of theorems and its uses	Tutorial	CO 1, 2,5	Class Quiz Home Assignment
FIRST SESSIONAL EXAM					
22	Number theoretic functions	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
23	Sum and number of divisors functions	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment

24	Totally multiplicative functions	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
25	The Möbius inversion formula	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
26	The greatest integer function	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
27	Euler's phi-function	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
28	Reduced set of residues	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
29	Some properties of Euler's phi-function	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
30	Definition and properties of the Dirichlet product	To know about multiplicative functions and their properties	Lecture	CO 3	Class Quiz Home Assignment
31	Problem Solving	To know about multiplicative functions and their properties	Tutorial	CO 3	Class Quiz Home Assignment
32	Primitive roots and quadratic residues	To learn quadratic residues	Lecture	CO 3	Class Quiz Home Assignment
33	Order of an integer modulo n	To learn quadratic residues	Lecture	CO 3	Class Quiz Home Assignment

34	Primitive roots for primes	To discuss the order of an integer and primitive roots	Lecture	CO 3	Class Quiz Home Assignment
35	Composite numbers having primitive roots	To discuss the order of an integer and primitive roots	Lecture	CO 3	Class Quiz Home Assignment
36	Theory of indices	To discuss the order of an integer and primitive roots	Lecture	CO 3	Class Quiz Home Assignment
37	Problem Solving	Problem solving technique	Tutorial	CO 3	Class Quiz Home Assignment
38	The quadratic reciprocity law	Understand the law of quadratic reciprocity	Lecture	CO 3,4,5	Class Quiz Home Assignment
39	Euler's criterion	Understand the law of quadratic reciprocity	Lecture	CO 4,5	Class Quiz Home Assignment
40	The Legendre symbol and its properties	Understand the law of quadratic reciprocity	Lecture	CO 4	Class Quiz Home Assignment
41	Quadratic reciprocity	Understand the law of quadratic reciprocity	Lecture	CO 4	Class Quiz Home Assignment
42	Quadratic congruence with composite moduli	Understand the law of quadratic reciprocity	Lecture	CO 4,5	Class Quiz Home Assignment
43	Jacobi symbol and its properties	Understand the law of quadratic reciprocity	Lecture	CO 4,5	Class Quiz Home Assignment
SECOND SESSIONAL EXAM					
44	Public key encryption	Concept of Public key encryption	Lecture	CO 1, 4	Class Quiz Home Assignment
45	RSA encryption and decryption	Concept of RSA encryption and decryption	Lecture	CO 3,4	Class Quiz Home Assignment
46	Problem Solving	Techniques for solving problems	Discussion	CO 3,4,5	Class Quiz Home Assignment

47	Representation of integers**:** Sums of two squares; Sums of more than two squares	Solve the Equations	Lecture	CO 4	Class Quiz Home Assignment
48	Certain nonlinear Diophantine equations: The equation $x^2 + y^2 = z^2$	Solve the Equations	Lecture	CO 4,5	Class Quiz Home Assignment
49	Fermat's Last Theorem	Techniques for solving problems	Lecture	CO 4	Class Quiz Home Assignment
50	Final Review	Understand the subject	Group Discussion	CO 1,2,3,4,5	Class Quiz Home Assignment
End Term Exam					

H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	**STATEMENT**	Correlation with Program Outcomes **(POs)**							Correlation with Program Specific Outcomes (**PSOs**)			
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO4**
[MA1204.1]	Enhanced the logical and analytical skill in the basic concepts of number theory.	**2**						**2**		**2**	**3**	**3**
[MA1204.2]	Describe the concepts of number theoretic functions and their properties.	**2**						**2**	**2**			
[MA1204.3]	Describe the concept of conjectures and their formation about the integers.	**2**						**2**			**1**	
[MA1204.4]	Describe the concept of Diophantine equations & Fermat's equation, their simplification which sharpen the problem-solving skills.	**2**						**2**	**1**	**1**		**2**
[MA1204.5]	Describe the concept of primitive roots and quadratic reciprocity law and properties.	**2**						**2**	**1**	**3**	**3**	**3**

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

DEPARTMENT OF Mathematics & Statistics

Course Hand-out

Abstract Algebra | MA1205| 4 Credits | 3 1 0 4

Session: Jan 20-May 20 | Faculty: Dr. Ashok Kumar Pal| Class: B.Sc. Mathematics (HONS) II SEM

A. **Introduction:** This course is offered by Dept. of Mathematics & Statistics, targeting students who wish to pursue research & development in pure mathematics field. This course is important to students whom majors are mathematics as it is the first step for them to be familiar with abstract topics in algebra; mainly binary operation on a set, group, subgroup and homomorphism. Abstract algebra is also an ideal capstone course for those who will go in to take postgraduate courses in mathematics. High school teachers should be very skilful at arithmetic, abstract algebra is the course where they learn this very well.

B. **Course Outcomes:** At the end of the course, students will be able to:

[MA 1205.1] Describe the basic concept of algebra and set theory.

[MA 1205.2] Recognize the different kind of groups and subgroups with their properties, which enhance their logical skills.

[MA 1205.3] Enhance the concept of special kind of groups and their uses for solving the mathematical problems, which make them employable.

[MA 1205.4] Describe the concept of mapping in group theory.

[MA 1205.5] Enhance the idea of results on group homomorphism and maximal subgroups.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking**: Critically interpret data, write reports and apply the basics of evidence

[PO.2]. **Effective Communication:** Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings

[PO.4]. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities.

[PO.6]. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

[PSO.1]. to understand the basic Mathematical & Statistical principles and to explain them clearly**.**

[PSO.2]. to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics**.**

[PSO.3]. to develop creative thinking and the power of imagination.

[PSO.4]. to expose the graduates in research in academia and industry for broader applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work at home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Group Theory: Binary operation on a set, algebraic structure, definition of a group, abelian group, finite and infinite groups, order of a group, properties of groups, addition modulo m, multiplication modulo p, residue classes of the set of integers; **Permutations:** Groups of permutations, cyclic permutation, even and odd permutations, integral powers of an element of a group, order of an element of a group; **Subgroups:** Intersection of subgroups, cosets, Lagrange's theorem, Euler's theorem, Fermat's theorem, order of the product of two subgroups of finite order, Cayley's theorem, cyclic groups, subgroup generated by a subset of a group, generating system of group; **Normal Subgroups:** Conjugate elements, characteristics subgroup normalizer of an element of a group, class equation of a group, centre of a group, conjugate subgroups, invariant subgroups, quotient groups; **Isomorphism and Homomorphism of Groups:** Kernel of a homomorphism; fundamental theorem on homomorphism of groups, automorphisms of a group, inner automorphisms, results on group homomorphism, maximal subgroups.

F. REFERENCE BOOKS

1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, 2nd edition, Cambridge University Press, 1994, reprint 2009.
2. N. S. Gopalakrishanan, University Algebra, New Age International (P) Ltd., 3rd edition, 2015.
3. Vijay K Khanna and S K Bhambri, A Course in Abstract Algebra, 4th edition, Vikas Publication House PVT Ltd, 2013.
4. J.B. Fraleigh, A first Course in Abstract Algebra, Pearson Education Limited, 2013.
5. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2013.
6. J. A. Gallian, Contemporary Abstract Algebra, Cengage learning, 2013.

G. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers expectations and understand student expectations	Lecture Interaction	-	NA
2	**Group Theory:** Binary operation on a set, algebraic structure, definition of a group	To ascertain the interest and recapitulate the understanding about the Group theory	Interaction, Discussion & Question Answer Session	CO 1	In Class Quiz (Not Accounted)
3	abelian group, finite and infinite groups, order of a group	To ascertain the knowledge about the Group theory	Interaction, Discussion & Question Answer Session	CO 1	1st Sessional ET Exam Home Assignment
4	properties of groups, addition modulo m, multiplication modulo p	To ascertain the knowledge about the properties	Interaction, Discussion & Question Answer Session	CO 1	
5	residue classes of the set of integers;	To ascertain the knowledge about the residue classes of the set	Interaction, Discussion & Question Answer Session	CO 1	
6	**Permutations:** Groups of permutations	To ascertain the knowledge about the permutation group	Interaction, Discussion & Question Answer Session	CO 1	1st Sessional ET Exam Home Assignment
7	cyclic permutation, even and odd permutations	To ascertain the knowledge about more the permutation group	Interaction, Discussion & Question Answer Session	CO 1	
8	integral powers of an element of a group		Interaction, Discussion & Question Answer Session	CO 1	
9	order of an element of a group	To know more about group properties	Interaction, Discussion & Question Answer Session	CO 1	1st Sessional ET Exam Home Assignment
10	**Subgroups:** Intersection of subgroups	To understand about subgroup	Interaction, Discussion & Question Answer Session	CO 2	
11	cosets	To know more about subgroup	Interaction, Discussion & Question Answer Session	CO 2	
12	Lagrange's theorem	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 2	1st Sessional ET Exam Home Assignment
13	Euler's theorem	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 2	
14	Fermat's theorem	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 2	
15	order of the product of two subgroups of finite order	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 2	1st Sessional ET Exam Home Assignment
16	Cayley's theorem	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 2	
17	cyclic groups	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	
18	subgroup generated by a subset of a group	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	1st Sessional ET Exam Home Assignment
19	subgroup generated by a subset of a group	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	
20	generating system of group	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	
21	Doubt class	To know the more of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	1st Sessional ET Exam
22	Doubt class	To know the more of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	

23	Doubt class	To know the more of group and subgroup	Interaction, Discussion & Question Answer Session	CO 3	Home Assignment
FIRST SESSIONAL EXAM					
24	Normal Subgroups:	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	2nd Sessional
25	Normal Subgroups:	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	ET Exam
26	Conjugate elements, characteristics subgroup	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	Home Assignment
27	normalizer of an element of a group,	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	2nd Sessional
28	class equation of a group	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	ET Exam
29	centre of a group	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	Home Assignment
30	conjugate subgroups	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	2nd Sessional
31	invariant subgroups	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	ET Exam
32	quotient groups	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	Home Assignment
33	quotient groups	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	2nd Sessional
34	Doubt class	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	ET Exam
35	Tutorial	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	Home Assignment
36	Doubt class	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	2nd Sessional
37	Doubt class	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	ET Exam
38	Doubt Class	To know the properties of group and subgroup	Interaction, Discussion & Question Answer Session	CO 4	Home Assignment
SECOND SESSIONAL EXAM					
39	**Isomorphism and Homomorphism of Groups:**	To know the about mapping on groups	Interaction, Discussion & Question Answer Session	CO 5	ET Exam
40	**Isomorphism and Homomorphism of Groups:**	To know the about mapping on groups	Interaction, Discussion & Question Answer Session	CO 5	
41	Kernel of a homomorphism;	To know the about mapping on groups	Interaction, Discussion & Question Answer Session	CO 5	
42	fundamental theorem on homomorphism of groups.	To know about properties of mapping	Interaction, Discussion & Question Answer Session	CO 5	ET Exam
43	automorphisms of a group,	To know about properties of mapping	Interaction, Discussion & Question Answer Session	CO 5	
44	inner automorphisms,	To know about properties of mapping	Interaction, Discussion & Question Answer Session	CO 5	
45	results on group homomorphism,	To know about properties of mapping	Interaction, Discussion & Question Answer Session	CO 5	
46	maximal subgroups	To deep understanding on subgroups.	Interaction, Discussion & Question Answer Session	CO 5	ET Exam
47	Doubt Class	To clear doubts	Interaction, Discussion & Question Answer Session	CO 5	ET Exam
48	Doubt Class	To clear doubts	Interaction, Discussion & Question Answer Session	CO 5	ET Exam
END TERM EXAM					

H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes **(POs)**							Correlation with Program Specific Outcomes (**PSOs**)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
[MA1205.1]	Describe the basic concept of algebra and set theory.	**1**		**1**					**2**			**1**
[MA1205.2]	Recognize the different kind of groups and subgroups with their properties, which enhance their logical skills	**2**		**1**		**1**		**1**		**1**		**1**
[MA1205.3]	Enhance the concept of special kind of groups and their uses for solving the mathematical problems, which make them employable .	**1**	**1**						**1**		**2**	**2**
[MA1205.4]	Describe the concept of mapping in group theory.	**2**		**1**	**1**						**3**	
[MA1205.5]	Enhance the idea of results on group homomorphism and maximal subgroups.		**2**				**1**		**1**			**2**

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics and Statistics

Course Hand-out

Three Dimensional Geometry | MA1206 | 4 Credits | 3 1 0 4

Session: Jan 20 – May 20 | Faculty: Dr. Reema Jain| Class: B. Sc. Mathematics (Hons) II Sem.

A. Introduction: This course provides a basic knowledge of three dimensional geometries especially sphere, cone and cylinders. Geometry is an essential branch in mathematics that helps students learn to grasp their environment and leverage that grasp into abstract understanding and reasoning. Three-dimensional space is a geometric setting in which three values are required to determine the position of an element (i.e. point). This is the informal meaning of the term dimension.

B. Course Outcomes: At the end of the course, students will be able to think logically.

[MA1206.1] Students will be able to define the direction cosines/ratios of a given line in space and the various forms of equation of a straight line and plane.

[MA1206.2] Students will be able to compute the angle between two lines, two planes and between a line & a plane, perpendicular distance from a point to a plane, image of a line on a plane.

[MA1206.3] Learners will be able to describe Sphere, Cone and Cylinder and it will enhance the skills.

[MA1206.4] Students will be able to understand the geometrical importance of conicoids.

[MA1206.5] Students will get an approach for hyperboloid of one sheet and two sheet and will apply the properties to solve problems in real life situations.

C. Program Outcomes and Program Specific Outcomes

[PO.1].Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
[PO.2].Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1]. To understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2]. To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

[PSO.3]. To develop creative thinking and the power of imagination.

[PSO.4]. To expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (Summative)	Sessional Exam I **(Closed Book)**	20
	Sessional Exam II **(Closed Book)**	20
	Quizzes , Assignments & Presentation	20
End Term Exam (Summative)	End Term Exam **(Closed Book)**	40
	Total	100

E. Syllabus

Line and Plane: Direction cosines of a line, direction ratios of the join of two points, projection on a line, angle between the lines, equation of line in different forms, equation of a plane in different forms, angle between two planes, line of intersection of two planes, angle between a line and a Plane; Sphere: Definition, equation of a sphere, general equation of a sphere, great circle, equation of circle, tangent line and tangent plane of a sphere, condition of tangency for a line and equation of tangent plane, angle of intersection of two spheres, condition of orthogonality of two spheres; Cone: Cone, quadratic cone, equation of a cone, enveloping cone, condition for general equation of second degree to represent a cone, intersection with a line, tangent plane, reciprocal cone, right circular cone; Cylinder: Definition, equation of a cylinder, enveloping cylinder, equation of enveloping cylinder, right circular cylinder, equation of right circular cylinder; Central Conicoids: Conicoids, central conicoid, standard equation of ellipsoid,

hyperboloid of one sheet and hyperboloid of two sheets, nature and shape of central conicoids, tangent line and tangent planes, condition of tangency.

F. Text Books:

1. Shanthi Narayan, Analytical Solid Geometry, New Delhi: S. Chand and Co. Pvt. Ltd., 2004.
2. R. J. T. Bell, Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India Ltd, 1998.

G. Reference Books:

1. S. L. Loney, The Elements of Coordinate Geometry, Macmillan and Co., London, 2001.
2. P. K. Jain and Khalil Ahmad, A text book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd, 2008.
3. N. Saran and R. S. Gupta, Analytical Geometry of Three Dimensions, Pothisala Pvt. Ltd, Allahabad, 2001.
4. Gorakh Prasad and H. C. Gupta, Text book on Coordinate Geometry, Pothisala Pvt. Ltd., Allahabad, 2004.
5. Sharma & Jain, Co-ordinate Geometry, Galgotia Publication, Dariyaganj, New Delhi, 1998.

H. Lecture Plan:

Class Number	Topic	Session Outcome	Mode of delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	Introduction: Three Dimensional Geometry	Students will get acquaintance with the basic concept of Three Dimensional Geometry	Lecture, Discussion & Examples	MA1206.1	Quizzes, Two Sessional, End Term Examination
2,3	Direction cosines & ratios	To develop the understanding of 3D coordinate system	Lecture, Discussion & Examples	MA1206.1	Quizzes, Two Sessional, End Term Examination
4,5	Various forms of line in 3D	Learn about line in 3D	Lecture, Discussion & Examples	MA1206.1	Quizzes, Two Sessional, End Term Examination
6	Equation of plane in different forms	Learn about plane	Lecture, Discussion & Examples	MA1206.1	Quizzes, Two Sessional, End Term Examination
7	Angle between two lines	Learn about line in 3D	Lecture, Discussion & Examples	MA1206.2	Quizzes, Two Sessional, End Term Examination

8	Angle between two planes	Learn about plane	Lecture, Discussion & Examples	MA1206.2	Quizzes, Two Sessional, End Term Examination
9	Angle between a line & a plane	Learn about angle between line & plane	Lecture, Discussion & Examples	MA1206.2	Quizzes, Two Sessional, End Term Examination
10	Line of intersection of two planes	Learn about plane	Lecture, Discussion & Examples	MA1206.2	Quizzes, Two Sessional, End Term Examination
11	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	MA1206.2	Quizzes, Two Sessional, End Term Examination
12,,13,14	**Sphere**: Definition; Equation of a sphere; General equation of a sphere; Diameter form, Centre & radius of a sphere	Learn about sphere	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
15	Great circle	Apply the concept of sphere	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
16,17	Tangent line and tangent plane of a sphere, condition of tangency for a line and equation of tangent plane;	Apply the concept of sphere	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
18,19, 20	Angle of intersection of two spheres; Condition of orthogonality of two spheres.	Apply the concept of sphere	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
21	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
22,23,24	**Cone**: Cone; Quadratic cone; Equation of a cone;	Understand the concept of cone	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
First Sessional Exam					
25,26	Enveloping cone; Condition for general equation of second degree to present a cone	Elaborate the concept of cone	Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
27,28,29	Intersection of a line and a plane; Angle between the intersecting lines of cone	Apply the concept of cone	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
30,31	Tangent plane; Reciprocal cone; Right circular cone	Apply the concept of cone	Lecture, Discussion	MA1206.3	Quizzes, Two Sessional,

			& Examples		End Term Examination
32	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
33,34	**Cylinder**: Definition; Equation of a cylinder;	Understand the concept of cylinder	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
35,36,37	Enveloping cylinder; Right circular cylinder.	Elaborate the concept of cylinder	Lecture, Discussion & Examples	MA1206.3	Quizzes, Two Sessional, End Term Examination
38,39,40	**Central Coinicoids:** The Standard equation; The ellipsoid;	Understand and Apply concept of conicoids	Lecture, Discussion & Examples	MA1206.4	Quizzes, Two Sessional, End Term Examination
41	**Tutorial Class**	Students will be able to apply the concepts	Lecture, Discussion & Examples	MA1206.4	Quizzes, Two Sessional, End Term Examination
Second Sessional Exam					
42,43	The hyperboloid of one sheet	Identify and explain the concept of hyperboloid of one sheet	Lecture, Discussion & Examples	MA1206.5	Quizzes, Two Sessional, End Term Examination
44,45,46	The hyperboloid of two sheets;	Apply the concept of hyperboloid of two sheet	Lecture, Discussion & Examples	MA1206.5	Quizzes, Two Sessional, End Term Examination
47,48,49	Nature and shape of central conicoids, tangent line and tangent planes, condition of tangency.	Students will be able to apply the concepts	Lecture, Discussion & Examples	MA1206.5	Quizzes, Two Sessional, End Term Examination
50	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	MA1206.5	Quizzes, Two Sessional, End Term Examination
End Term Exam					

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 1206.1	Students will be able to define the direction cosines/ratios of a given line in space and the various forms of equation of a straight line and plane.	3	2	1	2	1		3	3	3	2	1
MA 1206.2	Students will be able to compute the angle between two lines, two planes and between a line & a plane, perpendicular distance from a point to a plane, image of a line on a plane.	3	2	1	2	1		3	3	3	2	1
MA 1206.3	Learners will be able to describe Sphere, Cone and Cylinder and it will enhance the skills.	3	2	1	2	1		3	3	3	2	1
MA 1206.4	Students will be able to understand the geometrical importance of conicoids.	3	2	1	2	1	2	3	3	3	2	1
MA 1206.5	Students will get an approach for hyperboloid of one sheet and two sheet and will apply the properties to solve problems in real life situations.	3	2	1	2	1		3	3	2	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

PROBABILITY THEORY AND RANDOM VARIABLES | MA1240 | 3 Credits | 2 1 0 3

Session: Jan.2021 – May 2021 | Faculty: Dr. Monika Saini | Class: B.Sc. /B.A. II Sem.

A. Introduction:-

The use of statistical reasoning and methodology is indispensable in modern world. It is applicable to every discipline, be it physical sciences, engineering and technology, economics or social sciences. Much of the advanced research in electronics, electrical, computer science, industrial engineering, biology, genetics, and information science relies increasingly on use of statistical tools. It is essential for the students to get acquainted with the subject of probability and statistics at an early stage. The present course has been designed to introduce the subject to undergraduate/postgraduate students in science and engineering. The course contains a good introduction to each topic and an advance treatment of theory at a fairly understandable level to the students at this stage. Each concept has been explained through examples and application oriented problems.

A. Course Outcomes: At the end of the course, students will be able to

MA1240.1	Understand the concept of probability theory for decision making
MA1240.2	Understand conceptual framework of random variables.
MA1240.3	Understand conceptual framework of mathematical expectations
MA1240.4	Understand conceptual framework of generating functions to improve employability skills.

B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO.1	to teach a wide range of Mathematics & Statistics at a basic level and stimulate the interest of students in Mathematics & Statistics
PO.2	producing graduates who are well grounded in the fundamentals of Mathematics & Statistics and acquisition of the necessary skills, in order to use their knowledge in Mathematics & Statistics in a wide range of practical application.
PO.3	To acquire discipline – based skills in pure Mathematics, applied Mathematics, Mathematical Statistics and Operations research.
PO.4	To analyse situations, search for truth and extract information, formulate and solve problems in a systematic and logical manner.
PO.5	Graduates of the program will continue to learn and to adapt in a world of constantly evolving and innovative technology

PO.6 Function on multidisciplinary teams by working cooperatively, creatively and responsibly as a member of a team

PO.7 Pursue for Master's program in Mathematics, Statistics and Operations Research.

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

C. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

D. SYLLABUS:-

Probability Theory: Random experiments, sample space, event, algebra of events, Definitions of Probability, theorems on probability, Boole's inequality, conditional probability, independent events, Bayes theorem and its applications. **Random Variable:** Random Variable, distribution function, discrete random variable, probability mass function, distribution function of discrete random variable, continuous random variable, probability density function, distribution function of continuous random variable. joint probability mass function, marginal probability function, conditional probability function, joint distribution function, marginal distribution function Joint density function, marginal density function,

stochastic independence, independent random variables. **Mathematical Expectation:** Definition, expected value of random variable, expected value of a function of a random variable, addition and multiplication theorems and their generalizations, covariance, expectation and variance of a linear combination of random variable, Cauchy-Schwartz inequality, conditional expectation and conditional variance. **Generating Functions:** Definition, limitations and properties of moment generating function, uniqueness theorem, cumulates, properties of cumulates, effect of change or origin and scale. Characteristic function, properties of characteristic function, uniqueness theorem. Probability generating function.

E. TEXT BOOKS:-

1. Goon A.M., Gupta A.K. and Das Gupta B., Fundamental of Statistics, Vol. I, World Press, Calcutta, 1999.
2. Mood A.M., Greybill, F.A. and Bose D.C, Introduction to the Theory of Statistics, McGraw Hill, 1974.
3. Gupta S.C. and Kapoor V.K, Fundamentals of Mathematical statistics, Sultan Chand and Co.,3rd edition, New Delhi, 2008.
4. Meyer, P.L., Introductory Probability and Applications by Addison-Wesley, 1971.

F. REFERENCE BOOKS:-

1. Hoel P.G., Introduction to Mathematical Statistics, Asia Publishing House, 1971.
2. Snedecors G.W. and Cochran W.G., Statistical Methods, Iowa State University Press, 1967.
3. Goon A.M., Gupta M.K. and Das Gupta B., Fundamental of Statistics, Vol. I, World Press, Calcutta, 1991.

G. Lecture Plan:-

Lec. No.	Description of the Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Random experiments, sample space	Discussion on Random experiments, sample space	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
2	event, algebra of events,	Understanding event, algebra of events,	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
3	Definitions of Probability	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
4	Theorems on probability	Understanding concepts of Probability	Problem solving	MA1240.1	assignments, Two Sessional, End Term Examination
5	Theorems on probability	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination

6	Theorems on probability	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
7	Theorems on probability	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
8	Theorems on probability	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
9	Boole's inequality	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
10	Conditional probability	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
11	independent events	Understanding concepts of Probability	Lecture, Discussion & Examples	MA1240.1	assignments, Two Sessional, End Term Examination
12	Bayes theorem	Understanding concepts of Probability	Problem solving	MA1240.1	assignments, Two Sessional, End Term Examination
13	Class test	Class test	Test	MA1240.1	assignments, Two Sessional, End Term Examination
14	Random Variable, distribution function, discrete random variable	Use of Random Variable, distribution function, discrete random variable	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
15	probability mass function, distribution function of discrete random variable	Use of probability mass function, distribution function of discrete random variable	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
16	continuous random variable, probability density function, distribution function of	Use of continuous random variable, probability density function, distribution function of continuous random variable	Problem solving	MA1240.2	assignments, Two Sessional, End Term Examination

	continuous random variable				
17	Joint probability mass function, marginal probability function	Understanding concepts of Joint probability mass function, marginal probability function	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
18	, conditional probability function, joint distribution function,	Use of conditional probability function, joint distribution function,	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
19	marginal distribution function Joint density function,	Use of marginal distribution function Joint density function,	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
20	marginal density function, stochastic independence,	Use of marginal density function, stochastic independence,	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
21	independent random variables	Use of independent random variables	Lecture, Discussion & Examples	MA1240.2	assignments, Two Sessional, End Term Examination
22	Definition, expected value of random variable	Use of Definition, expected value of random variable	Problem Solving	MA1240.3	assignments, Two Sessional, End Term Examination
23	, expected value of a function of a random variable,	Use of expected value of a function of a random variable,	Lecture, Discussion & Examples	MA1240.3	assignments, Two Sessional, End Term Examination
24	addition and multiplication theorems and their generalizations	Use of addition and multiplication theorems and their generalizations	Lecture, Discussion & Examples	MA1240.3	assignments, Two Sessional, End Term Examination
25	covariance,	Use of covariance,	Lecture, Discussion & Examples	MA1240.3	assignments, Two Sessional, End Term Examination
26	expectation and variance of a linear combination of random variable	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.3	assignments, Two Sessional, End Term Examination

27	Cauchy-Schwartz inequality	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.3	, assignments, Two Sessional, End Term Examination
28	Conditional expectation	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.3	assignments, Two Sessional, End Term Examination
29	conditional variance	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.3	assignments, Two Sessional, End Term Examination
30	Definition, limitations and properties of moment generating function	Use of expectation and variance of a linear combination of random variable	Problem solving	MA1240.3	assignments, Two Sessional, End Term Examination
31	uniqueness theorem	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.4	assignments, Two Sessional, End Term Examination
32	cumulates, properties of cumulates	Use of expectation and variance of a linear combination of random variable	Problem solving	MA1240.4	assignments, Two Sessional, End Term Examination
33	effect of change or origin and scale	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.4	assignments, Two Sessional, End Term Examination
34	Characteristic function, properties of characteristic function	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.4	assignments, Two Sessional, End Term Examination
35	uniqueness theorem	Use of expectation and variance of a linear combination of random variable	Problem solving	MA1240.4	assignments, Two Sessional, End Term Examination
36	Probability generating function.	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.4	assignments, Two Sessional, End Term Examination
37	Probability generating function.	Use of expectation and variance of a linear combination of random variable	Lecture, Discussion & Examples	MA1240.4	assignments, Two Sessional, End Term Examination

H. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA1240.1	Understand the concept of probability theory for decision making	**2**			**2**			**3**				
MA1240.2	Understand conceptual framework of random variables		**2**	**3**		**2**						
MA1240.3	Understand conceptual framework of mathematical expectations	2		**3**			**1**					
MA1240.4	Understand conceptual framework of generating functions to improve employability skills.		**3**		**2**			**3**				

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY
JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

Lab on Probability Theory & Random Variables| MA1230 | 3 Credits | 0 0 2 1

Session: Jan. 2021– May 2021 | Faculty: Dr. Monika Saini | Class: B.Sc. /B.A. II Sem.

A. Introduction:-

The use of statistical reasoning and methodology is indispensable in modern world. It is applicable to every discipline, be it physical sciences, engineering and technology, economics or social sciences. Much of the advanced research in electronics, electrical, computer science, industrial engineering, biology, genetics, and information science relies increasingly on use of statistical tools. It is essential for the students to get acquainted with the subject of probability and statistics at an early stage. The present course has been designed to introduce the subject to undergraduate/postgraduate students in science and engineering. The course contains a good introduction to each topic and an advance treatment of theory at a fairly understandable level to the students at this stage. Each concept has been explained through examples and application oriented problems.

A. Course Outcomes: At the end of the course, students will be able to

1230.1	Understand the concept of probability theory for decision making and employability.
1230.2	Understand conceptual framework of random variables.
1230.3	Understand conceptual framework of mathematical expectations
1230.4	Understand conceptual framework of generating functions.

B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO.1	to teach a wide range of Mathematics & Statistics at a basic level and stimulate the interest of students in Mathematics & Statistics
PO.2	producing graduates who are well grounded in the fundamentals of Mathematics & Statistics and acquisition of the necessary skills, in order to use their knowledge in Mathematics & Statistics in a wide range of practical application.
PO.3	To acquire discipline – based skills in pure Mathematics, applied Mathematics, Mathematical Statistics and Operations research.
PO.4	To analyse situations, search for truth and extract information, formulate and solve problems in a systematic and logical manner.
PO.5	Graduates of the program will continue to learn and to adapt in a world of constantly evolving and innovative technology

PO.6 Function on multidisciplinary teams by working cooperatively, creatively and responsibly as a member of a team

PO.7 Pursue for Master's program in Mathematics, Statistics and Operations Research.

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

C. Assessment Plan:-

Criteria	Description	Maximum Marks
Lab	Practical Lab Exam	40
	Day to Day Assessment	60
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity will be assessed and marks will be awarded.	

D. SYLLABUS:-

Expected value of random variable, expected value of a function of a random variable, addition and multiplication theorems and their generalizations, covariance, expectation and variance of a linear combination of random variable, Cauchy-Schwartz inequality, conditional expectation and conditional variance, moment generating function, characteristic function and probability generating function.

E. Text Books:

1. M. J. Crawley, *Statistics: An Introduction Using R*, Wiley, 2015.
2. Gopal K. Kanji, *100 Statistical Tests*, SAGE Publication, 3rd edition, 2006.

E. REFERENCE BOOKS:-

1. Hoel P.G., Introduction to Mathematical Statistics, Asia Publishing House, 1971.
2. Snedecors G.W. and Cochran W.G., Statistical Methods, Iowa State University Press, 1967.
3. Goon A.M., Gupta M.K. and Das Gupta B., Fundamental of Statistics, Vol. I, World Press, Calcutta, 1991.

F. Lecture Plan:-

S No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode Of Assessing CO
1	Lab on Elementary Functions and Equations	Understand the Elementary Functions and Equations	Demonstration	1230.1	Quiz I, Viva voce & End Term
2	Program on Matrix Operation	Interpret and illustrate the concept of matrix operation	Demonstration	1230.1	Quiz I, Viva voce & End Term
3	Program on Matrix Operation	Interpret and illustrate the concept of matrix operation	Demonstration	1230.2	Quiz I, Viva voce & End Term
4	Program on Statistical Plots –I	Interpret and illustrate Statistical Plots	Demonstration	1230.2	Quiz I, Viva voce & End Term
5	Program on Statistical Plots –I	Interpret and illustrate Statistical Plots	Demonstration	1230.3	Quiz I, Viva voce & End Term
6	Program on Probability	Describe the conceptual framework of probabilistic phenomena	Demonstration	1230.3	Quiz I, Viva voce & End Term
7	Program on Random Variable-I	Describe framework of discrete Random variables	Demonstration	1230.3	Quiz II, Viva voce & End Term
8	Program on Random Variable-II	Describe framework of continuous Random variables	Demonstration	1230.3	Quiz II, Viva voce & End Term
9	Program on Random Variable-III	Describe framework of joint Random variables	Demonstration	1230.4	QuizII, Viva voce & End Term
10	Moments of Random variables-I	Describe framework of moments of Random variables	Demonstration	1230.4	Quiz II, Viva voce & End Term
11	Program on Bayes' theorem	conceptual framework of probabilistic phenomena	Demonstration	1230.4	QuizII, Viva voce & End Term

12	Moments of Random variables-II	Describe framework of moments of Random variables	Demonstration	1230.4	Quiz 11, Viva voce & End Term
13	Moments of Random variables-II	Describe framework of generating functions	Demonstration	1230.4	Quiz 11, Viva voce & End Term
14	End Term Exam				

G. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA1230.1	Understand the concept of probability theory for decision making and employability.	**2**			**2**			**3**				
MA1230.2	Understand conceptual framework of random variables		**2**	**3**		**2**						
MA1230.3	Understand conceptual framework of mathematical expectations	2		**3**			**1**					
MA1230.4	Understand conceptual framework of generating functions		**3**		**2**			**3**				

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1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

APPLIED STATISTICS | MA1241| 3 Credits | 2 1 0 3

Session: Jan. 21– May 21| Faculty: **Dr. Himanshu Rathore**| Class: B.Sc.

A. Introduction:-

Applied Statistics is the branch of statistics which provides a conceptual overview of statistical methods with emphasis on application in economics, business and research. It is an important subject and plays a key role in all spheres of data analysis. The course aims at providing the basics of estimation theory which emphasis on some commonly encountered estimation procedures.

B. Course Outcomes: At the end of the course, students will be able to

1241.1	Understand the concept of demand analysis.
1241.2	Understand conceptual framework of Index numbers.
1241.3	Understand conceptual framework of time series analysis.
1241.4	Understand conceptual framework of statistical Quality Control to increase employability and business skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1]. Critical thinking: Critically interpret data, write reports and apply the basics of evidence.

[PO2]. Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

[PSO.1]	to understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2]	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3]	to develop creative thinking and the power of imagination.
[PSO.4]	to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Demand Analysis: Laws of demand and supply, price and supply elasticity of demand, partial and cross elasticity of demand, income elasticity of demand, utility function, methods of determining demand and supply curves from family budget and time series date, Leontief's method, Pigou's method, Engel curve and its different forms, Pareto's law of income distribution, curves of concentration. **Index Numbers**: Introduction and their construction, Laspeyer's, Paashce's, Marshall –Edge Worth and Fisher's index numbers, tests for index numbers, uses of index numbers, price, quantity and value relatives, link and chain relatives, chain base index numbers, cost of living index numbers. **Time Series:** Analysis of time series, components of time series, trend measurement by mathematical curves, polynomial, growth curves, moving average method, Spencer's formulae, Effect of elimination of trend on other components of time series, variate difference method and its use for estimation of variance of the random component, measurement of seasonal fluctuations measurement of cyclical component, periodogram analysis. **Statistical Quality Control**: Control charts for variable and attributes. acceptance sampling by attributes- single, double, multiple and sequential sampling plans, concepts of AOQL and ATI, acceptance sampling by variables-use of Dodge-Romig and other tables.

F. TEXT BOOKS:-

1. Gupta, S.C. and Kapoor, V.K: Fundamentals of Applied statistics, Sultan Chand and Co., 3rd edition, New Delhi, 2008.
2. Benjamin, B., Health and Vital Statistics. G. Allen and Unwin, 1968.
3. Cox, P.R., Demography. Cambridge University Press, 1970.
4. Mukhopadhyay, P., Mathematical Statistics, Books & Allied (P) Ltd., 2009.

G. REFERENCE BOOKS:-

1. Goon A.M., Gupta M.K. and Das Gupta, B, Fundamentals of Statistics Volume-11, 2001.
2. Mukhopadhyay. P., Fundamental of Statistics Volume-11, 1999.
3. Agarwal, B.K., Basic Statistics, Wiley India Ltd., New Delhi, 1988.

H. Lecture Plan:-

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Demand Analysis**: Laws of demand and supply, price and supply elasticity of demand	Understand the basic terminology of demand and supply	Lecture	MA1241.1	Mid Term I Quiz Assignment End term
2,3	partial and cross elasticity of demand, income elasticity of demand, utility function	Understand the concept of elasticity	Lecture	MA1241.1	Mid Term I Quiz Assignment End term
4,5	methods of determining demand and supply curves from family budget and time series date	Become able to derive nature of curves of demand	Lecture	MA1241.1	Mid Term I Quiz Assignment End term
6	Leontief's method, Pigou's method,	Gain knowledge about Pigou method	Lecture	MA1241.1	Mid Term I Quiz Assignment End term
7	Engel curve and its different forms, Pareto's law of income distribution, curves of concentration.	Understand thew importance of Pareto method	Lecture	MA1241.1	Mid Term I Quiz Assignment End term
8,9	**Index Numbers**: Introduction and their construction, Laspeyer's, Paashce's, Marshall –Edge Worth and Fisher's index numbers,	Basic knowledge of index numbers	Lecture	MA1241.2	Mid Term I Quiz Assignment End term
10,11	tests for index numbers,	Familiarity with various methods	Lecture	MA1241.2	Mid Term I Quiz Assignment End term
12	uses of index numbers, price, quantity and value relatives	Implementations of various methods on real data	Lecture	MA1241.2	Mid Term I Quiz Assignment End term
13,14	link and chain relatives, chain base index numbers, cost of living index numbers.	Implementations of various methods on real data	Lecture	MA1241.2	Mid Term I Quiz Assignment End term
15	**Time Series:** Analysis of time series, components of time series,	Basic knowledge of time series data	Lecture	MA1241.3	Mid Term I Quiz Assignment End term
16,17	trend measurement by mathematical curves, polynomial, growth curves, moving average method, Spencer's formulae,	Various method's knowledge	Lecture	MA1241.3	Mid Term I Quiz Assignment End term
18,19, 20,21	Effect of elimination of trend on other components of time series, variate difference method and its use for estimation of variance of the random component,	Become able to develop time series model	Lecture	MA1241.3	Mid Term I Quiz Assignment End term
22	measurement of seasonal fluctuations	Can analyse seasonal effect	Lecture	MA1241.3	Mid Term II Quiz Assignment End term
23,24	measurement of cyclical component	Can analyse cyclic effect	Lecture	MA1241.3	Mid Term II Quiz

					Assignment End term
25, 26	periodogram analysis	Can analyse seasonal effect	Lecture	MA1241.3	Mid Term II Quiz Assignment End term
27, 28	**Statistical Quality Control**: Control charts for variable and attributes.	Knowledge about control charts	Lecture	MA1241.4	Mid Term II Quiz Assignment End term
29, 30 31, 32 ,33	acceptance sampling by attributes- single, double, multiple and sequential sampling plans,	Familiarity about acceptance sampling	Lecture	MA1241.4	Quiz Assignment End term
34,35, 36	Concepts of AOQL and ATI, acceptance sampling by variables- use of Dodge-Romig and other tables.	Usability of acceptance sampling in industry	Lecture	MA1241.4	Quiz Assignment End term

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA1241.1	Understand the concept of demand analysis.	**2**			**2**			**3**	**3**			
MA1241.2	Understand conceptual framework of Index numbers.		**2**	**3**		**2**						**3**
MA1241.3	Understand conceptual framework of time series analysis.	2		**3**			**1**				**3**	
MA1241.4	Understand conceptual framework of statistical Quality Control to increase employability and business skills		**3**		**2**			**3**		**3**		

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY
JAIPUR

School of Basic Sciences
Course Hand-out
Lab on Applied Statistics
| MA1231 | 1 Credit | 0 0 2 1

Session: March 21- June 21 | Faculty Dr. Himanshu Rathore | Class: B. Sc. (Maths Hons.)/B.A. (Eco. Hons.) 1st Year II

A. Introduction: The purpose of this course is to introduce the students to the basic knowledge of quantitative and qualitative data analysis with the help of statistical packages. The students learn to write set of instruction to create a program so that desire output can be generated by computer.

B. Course Outcomes: At the end of the course, students will be able to

[MA1231.1]. able to write a programme to find elasticity

[MA1231.2]. generate computer programme to analyze index number.

[MA1231.3]. analyze the time series using computer software which make them employable.

[MA1231.4]. employ this data analysis in future demand forecasting.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1]. Critical thinking: Critically interpret data, write reports and apply the basics of evidence.

[PO2]. Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

[PSO.1] to understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2] to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

[PSO.3] to develop creative thinking and the power of imagination.

[PSO.4] to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Lab	Practical Lab Exam	40
	Day to Day Assessment	60
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to	

(Formative)	participate and perform these assignments with full zeal since the activity will be assessed and marks will be awarded.

E. SYLLABUS

The following practical will be performed using statistical software: Trend analysis by using method of semi-averages, method of curve fitting, method of moving average, Spencer's 15 - point and 21 point – formulas, computation of seasonal variation indices by using ratio to trend method, ratio to moving average method, link relative method, measurement of cyclical component, periodogram analysis, estimation of parameters in ARIMA models, forecasting, exponential and adaptive smoothing models, construct of (i) $\bar{X}$ and R–chart (ii) p–chart (iii) c–chart.

F. Text Books

T1. M. J. Crawley, Statistics: An Introduction Using R, Wiley, 2015.
T2. G. K. Kanji, 100 Statistical Tests, SAGE Publication, 3rd edition, 2006.

G. Reference Books

R1. M. J. Crawley, Statistics: An Introduction Using R, Wiley, 2015.
R1. G. K. Kanji, 100 Statistical Tests, SAGE Publication, 3rd edition, 2006.

H. Lab Experiment Plan:

S No	Topics	Session Outcome	Mode of Delivery	*Corresponding CO*	Mode Of Assessing CO
1	Introduction to the lab course	Describe syllabus in details	Lecture	_	_
2	Program on elasticity function of the given data	Describe the key points to write and run program	Demonstration	1231.1	Mid Term I, Viva voce & End Term
3	Program on finding index numbers using various methods	Describe the key points to write and run program	Demonstration	1231.2	Mid Term I, Viva voce & End Term
4	Program on Time Series plot of the given data set	Describe the key points to write and run program	Demonstration	1231.3	Mid Term I, Viva voce & End Term
5	Program on computing and drawing trend line of the data set	Describe the key points to write and run program	Demonstration	1231.3	Mid Term I, Viva voce & End Term
6	Program on fitting of linear trend line of the data set	Describe the key points to write and run program	Demonstration	1231.3	Mid Term I, Viva voce & End Term
7	Program on fitting of quadratic curve line of the data set	Describe the key points to write and run program	Demonstration	1231.3	Mid Term I, Viva voce & End Term
8	Program on fitting of exponential curve line of the data set	Describe the key points to write and run program	Demonstration	1231.3	Mid Term I, Viva voce & End Term
9	Program on finding the trend line using semi averages and moving averages	Describe the key points to write and run program	Demonstration	1231.4	Mid Term I, Viva voce & End Term
10	Program on construction of X bar and R charts	Describe the key points to write and run program	Demonstration	1231.4	Mid Term I, Viva voce & End Term
11	Program on finding the seasonal indices of the data set	Describe the key points to write and run program	Demonstration	1231.4	Mid Term I, Viva voce & End Term
12	Program on construction of p and np charts	Describe the key points to write and run program	Demonstration	1231.4	Mid Term I, Viva voce & End Term
13	Program on construction of c-chart	Describe the key points to write and run program	Demonstration	1231.4	Mid Term I, Viva voce & End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA 1231.1:	able to write a programme to find elasticity	3											1	3		
MA 1231.2:	generate computer programme to analyze index number	2													2	
MA 1231.3:	analyze the time series using computer software	2		1									2	2		
MA 1231.4:	employable for data analysis	1											2	1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand-out

Real Analysis| MA 2112 | 4 Credits | 4 0 0 4

Session: Aug. 2020 – Dec.2020 | Class: B.Sc. (Hons.) Mathematics | Course Coordinator: Dr. Ashok Kumar Pal

A. Introduction: Dept. of Mathematics & Statistics offer the course Real Analysis for B.Sc. Hon. Mathematics Students. The aim of this course to motivate students to develop research ability in students by theoretical approach and create interest in pure mathematics. The course will develop a depth understanding of Real Analysis by some concept of Analysis Real numbers, Real sequences, Infinite series, Functions of a single variable. The course will develop mental ability in problem solving.

B. Course Outcomes: At the end of the course, students will be able to

[MA2112.1] Describe the concept of order field and order structure of real numbers, limit points of set, etc.
[MA2112.2]. Describe the concept of neighbourhood, interior point, open set, limit point, closed set etc.
[MA2112.3] Describe the concept of convergence and divergence of sequence, which enhance their problem-solving skills.
[MA2112.4] Describe the concept of convergence and divergence of series by using different types of tests, which enhance their problem-solving skills.
[MA2112.5] Evaluate the solution of mathematical problems, which make them employable.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Critical thinking:** Critically interpret data, write reports and apply the basics of evidence.
[PO.2]. **Effective Communication:** Communicate effectively by writing, connecting people, ideas, books, media, and technology.
[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO.4]. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering**.**
[PO.5]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities.
[PO.6]. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2]. To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics.
[PSO.3]. To develop creative thinking and the power of imagination
[PSO.4]. To expose the graduates in research in academia and industry for broader applications.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	Quizzes and Assignments	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100

Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.
Quizzes	3 Quizzes (Close Book)

E. Syllabus

Real Numbers: Field structure and order structure, order properties of R and Q, characterization of interval, bounded and unbounded sets, supremum and infimum, order completeness property, archimedean property, density of rational numbers in R, density theorem, characterization of intervals, absolute value of a real number, neighborhoods, open sets, closed sets, limit points of a set, Bolzano-Weierstrass theorem, isolated points, closure, nested interval, cantor nested interval theorem, cover of a set, compact set, Heine-Borel theorem, idea of countable sets, uncountable sets and uncountability of R;

Real Sequences: Sequences, bounded sequences, convergence of sequences, limit point of a sequence, Bolzano-Weierstrass theorem for sequences, limits superior and limits inferior, Cauchy's general principle of convergence, Cauchy sequences and their convergence criterion; Algebra of Sequences: Cauchy's first and second theorems and other related theorems, monotonic sequences, subsequences;

Infinite Series: Definition of infinite series, Sequence of partial sums, convergence and divergence of infinite series, Cauchy's general principle of convergence for series, positive term series, geometric series, comparison series; Comparison Tests: Cauchy's nth root test; Ratio test, Raabe's test, Logarithmic test, Cauchy's Integral test, Gauss test, alternating series and Leibnitz's theorem, absolute and conditional convergence.

F. Reference Book:

1. S. C. Malik and S. Arora, Mathematical Analysis, New Age Int. Pub., New Delhi, 2017.
2. S. C. Malik and S. Arora, Mathematical Analysis, New Age Int. Pub., New Delhi, 2017.
3. Shanti Narayan, Elements of Real Analysis, S. Chand & Co., New Delhi, 2015.
4. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd edition, John Wiley & Sons, 2011.
5. W. Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw Hill, New York, 2013.
6. H. L. Royden and P. M. Fitzpatrick, Real Analysis, 3rd edition, Macmillan, New York, 2010.
7. T. M. Apostal, Mathematical Analysis, Addison-Wesley, 2008.
8. R. R. Goldberg, Methods of Real Analysis, John Wiley & Sons, 2012.

G. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery (Online/Classroom)	Corresponding CO	Mode of Assessing the Outcome
1	Introduction, aims and objectives of the course and elementary fundamentals of Real Analysis	Know the basics of the course and understand its applications	Lecture Online	MA2112.1	Assignments Class Quiz Mid-Term I End-Term
2	Real Numbers: Field structure and order structure, order properties of R and Q, characterization of interval,	Discuss the terms Field structure, order structure.	Lecture Online	MA2112.1	
3	bounded and unbounded sets, supremum and infimum.	Understand the bounded and unbounded set.	Lecture Online	MA2112.1	
4	order completeness property, archimedean property, density of rational numbers in R, density theorem	Understand the completeness properties.	Lecture Online	MA2112.1	
5	neighbourhoods, open sets, closed sets,	Know the basics of the nbd, open set	Lecture Online	MA2112.2	
6	limit points of a set, Bolzano-Weierstrass theorem, isolated points	Know the basics of the, limit points.	Lecture Online		

7	closure, nested interval, cantor nested interval theorem, cover of a set, compact set,	Understand the concept of closure, nested interval, cantor nested interval.	Lecture Online	MA2112.2	
8	cover of a set, compact set,	Understand the concept of cover of the set.	Lecture Online	MA2112.2	
9	Heine-Borel theorem;	Know the concept of cover	Lecture Online	MA2112.2	
10	Idea of countable sets, uncountable sets and uncountability of R	basics of the countable sets and uncountable set.	Lecture Online	MA2112.2	
11	Problem solve and doubt class	To understand the problem.	Lecture Online	MA2112.2	
12	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.2	
13	Real Sequences: Sequences	Know the concept of real sequence	Lecture Online	MA2112.3	
14	Bounded sequences,	Know the basics of the bounded and unboundedness	Lecture Online	MA2112.3	
15	convergence of sequences	Know the basics of the convergence of the sequences	Lecture Online	MA2112.3	
16	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.3	
17	limit point of a sequence	Know the concept of limit of the sequences	Lecture Online	MA2112.3	
18	Bolzano-Weierstrass theorem for sequences, limits superior and limits inferior,	Know the basics of limit of a sequences.	Lecture Online	MA2112.3	
19	Cauchy's general principle of convergence,	Know the concept of convergence sequences.	Lecture Online	MA2112.3	
20	Cauchy sequences and their convergence criterion	Know the concept of convergence sequences	Lecture Online	MA2112.3	
21	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.3	
22	Algebra of Sequences: Cauchy's first theorem	Know the concept of convergence sequences	Lecture Online	MA2112.3 MA2112.5	
23	Cauchy's second theorems and other related theorems	Know the concept of convergence sequences	Lecture Online	MA2112.3	
24	Cauchy's second theorems and other related theorems	Know the concept of convergence sequences	Lecture Online	MA2112.3	
25	Discussion more about theorems	Know the concept of convergence sequences	Lecture Online	MA2112.3 MA2112.5	
26	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.3	
27	monotonic sequences	Understand the impulse and reaction turbine	Lecture Online	MA2112.3	
28	monotonic sequences and its properties	Understand the concept of monotonic sequences.	Lecture Online	MA2112.3 MA2112.5	
29	Theorems on monotonic sequences.	Understand the concept of monotonic sequences.	Lecture Online	MA2112.3	
30	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.3	

Assignments
Class Quiz
Mid-Term II
End-Term

31	Discussion more about monotonic sequences.	Understand the concept of monotonic sequences.	Lecture Online	MA2112.3 MA2112.5	
32	subsequences;	Understand the concept of subsequences.	Lecture Online	MA2112.3	
32	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.3 MA2112.5	
33	Theorem on subsequences	Understand the concept of subsequences.	Lecture Online	MA2112.3	
34	Infinite Series: Definition of infinite series, Sequence of partial sums,	Understand the concept of infinite series	Lecture Online	MA2112.4	
35	Discussion of the problems	To understand the problem.	Lecture Online	MA2112.4 MA2112.5	
36	Discussion of infinite series and its example	Know the basics of the infinite series	Lecture Online	MA2112.4	
37	convergence and divergence of infinite series	Know the concept of convergence and divergence series.	Lecture Online	MA2112.4	
38	Cauchy's general principle of convergence for series	Know the concept of convergence and divergence series.	Lecture Online	MA2112.4	
39	positive term series	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	
40	geometric series,	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	
41	Comparison series; Comparison Tests:	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	
42	Cauchy's nth root test; Ratio test,	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	
43	Raabe's test,	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	Assignments Class Quiz End-Term
44	Logarithmic test,	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	
45	Discussion of the test	Know the concept of convergence and divergence series	Lecture Online	MA2112.4 MA2112.5	
46	Cauchy's Integral test, Gauss test,	Know the concept of convergence and divergence series	Lecture Online	MA2112.4	
47	alternating series and Leibnitz's theorem	Understand the concept of Alternating series	Lecture Online	MA2112.4	
48	Discussion of alternating series	Understand the concept of Alternating series	Lecture Online	MA2112.4 MA2112.5	
49	absolute and conditional convergence.	Know the concept of convergence and divergence of Alternating series	Lecture Online	MA2112.4 MA2112.5	

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA2112.**1**	Describe the concept of order field and order structure of real numbers, limit points of set, etc.	1							2	3	3	2
MA2112.**2**	Describe the concept of neighbourhood, interior point, open set, limit point, closed set etc.	1							3	2		2
MA2112.**3**	Describe the concept of convergence and divergence of sequence, which enhance their problem-solving skills.	1			2				2	2	2	2
MA2112.**4**	Describe the concept of convergence and divergence of series by using different types of tests, which enhance their problem-solving skills.	1			2				3	1		2
MA2112.**5**	Evaluate the solution of mathematical problems, which make them employable.	1							1	1	2	2

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand-out

Ring & Field Theory | MA2113| 4 Credits | 3104

Session: August 2020 – Dec 2020 | Faculty: Dr Pooja Sharma | Class: B.Sc. Hons III sem.

A. Introduction:

This course is offered by Dept. of Mathematics & Statistics, targeting students who wish to pursue research & development in pure mathematics field. This course is important to students whom majors are mathematics as it is the first step for them to be familiar with abstract topics in algebra; mainly groups, rings, fields and their property. Ring and field theory is also an ideal capstone course for those who will go on to take postgraduate courses in mathematics.

B. Course Outcomes: At the end of the course, students will be able to

2113.1	Demonstrate knowledge and understanding of fundamental concepts including Rings, and Integral domains
2113.2	Demonstrate knowledge and understanding of fundamental concepts homomorphism and imbedding of ring. Apply algebraic ways of thinking in Employability Master the standard computations of ring theory.
2113.3	Demonstrate knowledge and understanding of fundamental concepts of Euclidean and Factorization domains and their properties
2113.4	Understand and prove fundamental results of polynomial rings and solve algebraic problems using appropriate techniques to improve skill development
2113.5	Understand and prove the fundamental results of field theory

C. Program Outcomes and Program Specific Outcomes

[PO1] Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2] Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3] Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4] Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5] Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6] Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7] Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

[PSO.1]	To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2]	To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3]	To develop creative thinking and the power of imagination.
[PSO.4]	To expose the graduates in research in academia and industry for broader applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	The classes will be taken online. A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. Syllabus

Rings: Zero divisors, commutative ring with identity, integral domains, division rings, subrings and ideals, congruence modulo a subring relation in a ring, simple ring, algebra of ideals, ideal generated by a subset, quotient rings, prime and maximal ideals,

homomorphism in rings, natural homomorphism, kernel of a homomorphism, fundamental theorem of homomorphism, first and second isomorphism theorems, field of quotients, embedding of rings, ring of endomorphism of an abelian group;

Factorization in Integral Domains: Prime and irreducible elements, H.C.F. and L.C.M. of two elements of a ring, principal ideals domains, **Euclidean domains, unique factorization domains**, polynomials rings, algebraic and transcendental elements over a ring, Factorization in polynomial ring R[x], division algorithm in R[x] where R is a commutative; Ring with Identity: Properties of polynomial ring R[x] if R is a field or a U.F.D., Gauss lemma, Gauss Theorem and related examples;

Field: Field extensions, finite field extensions, finitely generated extensions of a field, simple extension of a field, algebraic extension of a field, splitting (Decomposition) fields, multiple roots, normal and separable extension of a field.

F References:

1. S. Singh, Q. Zameeruddin, Modern Algebra, Vikas Pub. House Pvt Limited, 2009.
2. J.B. Fraleigh, A first Course in Abstract Algebra, Pearson Education Limited, 2013.
3. J. A. Gallian, Contemporary Abstract Algebra, 9th edition, Cengage Learning, USA, 2010.
4. I.T. Adamson, Introduction to Field Theory, New edition, Cambridge University Press; 2012.
5. Khanna & Bhambri, A course in abstract algebra, Third edition, Vikas publication, 2011

G. Lecture Plan:

LEC NO.	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction about the course plan and Assessment plan	To develop the understanding about the subject	Lecture	2113.1	NA
2	Definition Ring and their properties	To develop the Idea about the ring	Lecture	2113.1	Mid term Exam, End Term Exam, Quiz, Assignment
3, 4	Zero divisors Commutative ring with identity, integral domains, division rings	Knowledge of different kind of rings and Integral domain	Lecture	2113.1	Mid term Exam, End Term Exam, Quiz, Assignment
5,6	subrings and their properties, simple ring,	To understand the theory of different subrings	Lecture	2113.1	Mid term Exam, End Term Exam, Quiz, Assignment
7, 8	ideals, algebra of ideals	To understand the theory of ideals	Lecture	2113.1	Mid term Exam, End Term Exam, Quiz, Assignment
9, 10	ideal generated by a subset and their properties	To understand the theory of ideals and their properties	Lecture	2113.1	Mid term Exam, End Term Exam, Quiz, Assignment
11	Quotient rings, congruence modulo a subring relation in a ring	To understand the concept of Quotient rings	Lecture	2113.1	Mid term Exam, End Term Exam, Quiz, Assignment
12	**homomorphism in rings**, natural homomorphism, kernel of a homomorphism	To understand the concept of homomorphism in ring theory	Lecture	2113.2	Mid term Exam, End Term Exam, Quiz, Assignment
13, 14	Fundamental theorem of homomorphism, first and second isomorphism theorems,	To understand the basic properties of homomorphism	Lecture	2113.2	Mid term Exam, End Term Exam, Quiz, Assignment
15, 16, 17	Imbedding of rings, ring of endomorphism of an abelian group	To understand the idea of imbedding of rings	Lecture	2113.2	Mid term Exam, End Term Exam, Quiz, Assignment
18, 19	More on ideals, prime and maximal ideals	To develop the knowledge of ideals and their kinds	Lecture	2113.2	Mid term Exam, End Term Exam, Quiz, Assignment
20, 21	principal ideals domains	To develop the concept of principle ideals domain	Lecture	2113.2	Mid term Exam, End Term Exam, Quiz, Assignment
22, 23	Euclidean domains, unique factorization domains,	To understand the factorization domains	Lecture	2113.3	Mid term Exam, End Term Exam, Quiz, Assignment
24, 25	Factorization in Integral Domains: H.C.F. and L.C.M. of two elements of a ring,	To understand the factorization domains	Lecture	2113.3	Mid term Exam, End Term Exam, Quiz, Assignment
26, 27	Prime and irreducible elements	To understand the concept of polynomial rings	Lecture	2113.3	Mid term Exam, End Term Exam, Quiz, Assignment
28, 29	polynomials rings, algebraic and transcendental elements	To understand the concept of polynomial rings	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment

30, 31	Factorization in polynomial ring R[x], division algorithm in R[x] where R is a commutative; Ring	To understand the concept of factorization of polynomial rings	Lecture	2113.4	Midt erm Exam, End Term Exam, Quiz, Assignment
32, 33	With Identity: Properties of polynomial ring R[x] if R is a field or a U.F.D., over a ring,	To understand the concept of factorization of polynomial rings	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
34,35	Gauss lemma, Gauss Theorem and related examples	To understand the basic theorems	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
36, 37	**Field:** Field extensions, finite field extensions,	Knowledge of field theory	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
38, 39	Finitely generated extensions of a field, simple extension of a field	Knowledge of field extension	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
40, 41, 42	Algebraic extension of a field,	Knowledge of field extension	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
43, 44	splitting (Decomposition) fields,	Understand the concept of Decomposition fields	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
45, 46	Multiple roots, normal extension of a field	Knowledge of field normal extension	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment
47, 48	Separable extension of a field.	Knowledge of field Separable extension	Lecture	2113.4	Mid term Exam, End Term Exam, Quiz, Assignment

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
2113.1	Demonstrate knowledge and understanding of fundamental concepts including Rings, and Integral domain	3		1						1		
2113.2	Demonstrate knowledge and understanding of fundamental concepts homomorphism and imbedding of ring. Apply algebraic ways of thinking in Employability Master the standard computations of ring theory.	2	2	2				3	2	2		
2113.3	Demonstrate knowledge and understanding of fundamental concepts of Euclidean and Factorization domains and their properties			2	2	2				2	2	
2113.4	Understand and prove fundamental results of polynomial rings and solve algebraic problems using appropriate techniques to improve skill development	2		1			2	2		1		
2113.5	Understand and prove the fundamental results of field theory	2		1				2		1		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

DEPARTMENT OF MATHEMATICS & STATISTICS

Course Hand-Out

Linear Programming Problems | MA2114 | 4 Credits | 3 1 0 4

Session: July 20 - December 20 | Faculty: Dr. Vivek Singh | Class: B.SC. Mathematics (HONS) III SEM

A. Introduction: This course is offered by Dept. of Mathematics & Statistics as a regular course, targeting students who wish to pursue B.Sc. (Hons) Mathematics. We will begin with a general overview of allocation problems: linear programming its applications and then go into more detail about different allocation techniques as transportation and assignment problem use in decision-making process. In real life, linear programming is part of a very important area of mathematics called "optimization techniques". This field of study (or at least the applied results of it) are used every day in the organization and allocation of resources. So, the objective of this course is to provide a theoretical & application knowledge of linear programming problems.

B. Course Outcomes: At the end of the course, students will be able to

[2114.1]. Demonstrate the applications of linear programming and apply the solution methods for linear programming models.

[2114.2]. Describe the simplex method to solve maximum and minimum linear programming problems from everyday life and develop employability skills.

[2114.3]. Understand the meaning of weak and strong duality and their role in the design and verification of algorithmic solutions to linear programming problems which helps to increase the logical skills.

[2114.4]. Describe the transportation models and the solution methods in real life problems, which enhance the analytical skills.

[2114.5]. Recognizes and develops the assignment model solution methods and Computational procedure of the dual simplex algorithm.

A. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. To understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2]. To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics.

[PSO.3]. To develop creative thinking and the power of imagination.

[PSO.4]. To expose the graduates in research in academia and industry for broader applications.

B. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

C. SYLLABUS

Linear Programming Problems (LPP): Introduction, formulation of an LPP, Graphical method of solution of LPP, Areas of application of linear programming; **Optimal Solution:** Definitions, convex combination and convex set, extreme point, convex hull and convex polyhedron; **Simplex Method:** Fundamental theorem of linear programming, reduction of a feasible solution to a basic feasible solution, optimality condition, unboundedness, simplex algorithm, simplex method for maximization case of an LPP, minimization case- Big M method, Two phase method; **Duality:** concept of duality, mathematical formulation of duals-construction of duals, duality and simplex method; **Dual Simplex Method:** Introduction, dual simplex method, computational procedure of the dual simplex algorithm, initial basic solution; **Transportation Problem:** Introduction, mathematical formulation, initial solution by North West corner rule, Least Cost Method and Vogel's approximation method (VAM), MODI's method for testing optimality, special cases of transportation problem; **Assignment Problem:** Mathematical formulation, Hungarian method to find optimal assignment, unbalanced assignment problem.

D. Text Books:

1. J. G. Chakraborty and P. R. Ghosh, Linear Programming and Game Theory, Maulik Library, Kolkata, 2010.
2. J. K. Sharma, Operations Research, Macmilan Pub. India Ltd., 2013.

E. Reference Books:

1. Taha, Operations Research – An Introduction, 6th Edition, Prentice Hall of India, New Delhi, India, 1996.
2. V. K. Kapoor, Operations Research, Sultan Chand & Sons., New Delhi, India, 2005.
3. S. D. Sharma, Operations Research, Kedarnath Ramnath, Meerut, 2013.
4. G. Hadley, Linear Programming, Narosa Publications, 2002.

F. Lecture Plan:

LEC NO	TOPICS	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction; formulation of an LPP	To acquaint and clear teachers' expectations and understand student expectations	Flipped Classroom	2114.1	NA
2	General form of linear programming problem	Recall General form of LPP	Lecture	2114.1	In Class Quiz (Not Accounted)
3	Graphical method of solution of LPP	Explain solution of Graphical method in LPP	Flipped Classroom	2114.1	In Class Quiz
4, 5	Nature of the solution of an LPP; Areas of application of linear programming	Recall real life applications and solution of LPP	Lecture	2114.1	Home Assignment
6	Characteristic of an optimal solution: Definitions	Explain Definitions and Characteristic of an optimal solution in LPP	Lecture	2114.1	In Class Quiz
7, 8	Convex combination and convex set; A few important results	Recall applications in Convex combination and convex set and explain the numerical solution.	Lecture	2114.1	Class Quiz
9, 10, 11	Extreme point; Convex hull and convex polyhedron;	Explain Extreme point; Convex hull and convex polyhedron in LPP and formation of the method	Lecture	2114.1	Class Quiz
12	Standard form of an LPP	Explain the Standard form of an LPP and describe their formation and scope	Lecture	2114.1	Home Assignment Class Quiz
13, 14	Simplex method: Fundamental theorem of linear programming;	Explain the problems in Simplex method and Fundamental theorem of linear programming.	Lecture	2114.1	Class Quiz
15, 16	Reduction of a feasible solution to a basic feasible solution; Some definitions and notations;	Explain Reduction of a feasible solution to a basic feasible solution.	Lecture	2114.1	Class Quiz
17, 18, 19	Improving a basic feasible solution; Optimality condition	Recall Improving a basic feasible solution; Optimality condition and explain the numerical solution	Activity (Think Pair Share)	2114.3 2114.4	Class Quiz
20, 21	Unboundedness; Alternative optima;	Analyse and Identify the solution of Unboundedness and Alternative optima	Jigsaw	2114.1 2114.3	Class Quiz
22	Simplex algorithm; Procedural techniques	Examine the Problem related to Simplex algorithm; Procedural techniques	Lecture	2114.2	Class Quiz
23, 24	Initial basic feasible solution; Simplex tableau;	Describe Initial basic feasible solution and Simplex tableau	Lecture, Activity	2114.2	, Home Assignment Class Quiz
25	Computational procedure in simplex method;	Describe the solution of Computational procedure in simplex method	Lecture	2114.2	Class Quiz
26, 27	Simplex method for maximization of an LPP standard form;	Describe the solution of Simplex method for maximization of an LPP standard form	Lecture	2114.2	Class Quiz
38, 29	Minimization problem in standard form;	Explain the Solution of Minimization problem in standard form;	Lecture	2114.2	Class Quiz
30	Big M method;	Explain and solve the Big M method;	Lecture	2114.2	Home Assignment Class Quiz
31, 32	Two phase method	Describe and solve Two phase method	Lecture	2114.2	Class Quiz
33, 34	Duality: Concept of duality; Mathematical formulation of duals-construction of duals;	Describe the algebraic method for Duality: Concept of duality; Mathematical formulation of duals-construction of duals;	Lecture	2114.3	Class Quiz

35	Duality theorems; Complementary slackness;	Describe the working process of Duality theorems; Complementary slackness;	Lecture	2114.3	Class Quiz
36, 37	Duality and simplex method.	Describe the uses and application of Duality and simplex method.	Lecture, Activity	2114.3	Class Quiz
38, 39	Transportation: Introduction to transportation problem; Initial basic feasible solution;	Explain and Identify the transportation problem; Initial basic feasible solution;	Lecture, Activity	2114.4	Home Assignment
40, 41	Moving towards optimality; Degeneracy in transportation problems;	Examine Moving towards optimality; Degeneracy in transportation problems;	Lecture, Activity	2114.4	Class Quiz
42	Unbalanced transportation problem.	Describe determination of Unbalanced transportation problem.	Lecture	2114.4	Class Quiz
43, 44, 45	Assignments: Mathematical formulation of assignment problems; Hungarian method for solving assignment problem	Explain Application based problems of Assignments: Mathematical formulation of assignment problems; Hungarian method for solving assignment problem	Lecture, Activity	2114.5	Home Assignment Class Quiz
46	Unbalanced assignment problem;	Explain and summarization to properties and application of Unbalanced assignment problem;	Lecture	2114.5	Class Quiz
47, 48	Travelling salesman problem; Formulation of travelling salesman problem as an assignment problem and solution procedure.	Describe the Travelling salesman problem; Formulation of travelling salesman problem as an assignment problem and solution procedure.	Lecture, Activity	2114.5	Home Assignment Class Quiz
49, 50	Dual simplex method: Introduction; Dual simplex method;	Identify and Explain the Dual simplex method	Lecture	2114.5	Class Quiz
51, 52	Computational procedure of the dual simplex algorithm; Initial basic solution.	Recall the Computational procedure of the dual simplex algorithm; Initial basic solution.	Lecture	2114.5	Home Assignment Class Quiz

G. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA2114.1	Demonstrate the applications of linear programming and apply the solution methods for linear programming models.	3		1				2	3	2	3	3
MA2114.2	Describe the simplex method to solve maximum and minimum linear programming problems from everyday life and develop employability skills.	3		2			1	2	3	3	3	3
MA2114.3	Understand the meaning of weak and strong duality and their role in the design and verification of algorithmic solutions to linear programming problems which helps to increase the logical skills.	3		1				2	3	3	3	3
MA2114.4	Describe the transportation models and the solution methods in real life problems, which enhance the analytical skills.	3					1	2	2	2	2	3
MA2114.5	Recognizes and develops the assignment model solution methods and Computational procedure of the dual simplex algorithm.	3						2	2	2	3	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

DATA ANALYSIS USING R | MA2115 | 1 Credits | 2 0 0 2

Session: Aug. 20 – Dec. 20 | Faculty: **Dr. Ashish Kumar** | Class: B.Sc. III Sem.

A. Introduction:-

This course covers everything you need to learn to work as a data analyst using R. You'll learn the fundamentals of R syntax, dig into data analysis and data viz using popular packages, query databases with study statistics, among other things. Each lecture is designed so that there are no prerequisites and no prior experience required. Everything you need to learn to work as a data analyst, you'll learn on this course.

B. Course Outcomes: At the end of the course, students will be able to

2115.1	Interpret and illustrate the concept of Basic and intermediate programming concepts
2115.2	Modern R workflows with RStudio package
2115.3	Understand graphical representation of data using R.
2115.4	Probability and statistics for data analysis using R
2115.5	Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.
PSO.2	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
PSO.3	to develop creative thinking and the power of imagination.
PSO.4	to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

General Introduction into the R Ecosystem: Downloading and installing R, History of R, R packages, CRAN. Introduction to RStudio, Vector, Matrices and Arrays, Factors and Data Frames, Lists, Conditional and Control Flow; **R Syntax Basics**: Constants, operators, functions, variables, Random numbers, Vectors and vector indexing, simple descriptive stats, Loops, Conditional expressions; **Data Management:** Creating, recoding renaming variables, missing values, sorting, merging. Data Interface, CSV files, Excel files; **Charts and Graphs:** Introduction, Pie Chart, Bar Chart, Box Plot, Histogram, Line Graph and Scatter Plot.

F. TEXT BOOKS:-

1. M. Gardener: *Beginning R: The Statistical Programming Language*, Wiley Publications, 2012.
2. W. J. Braun and D. J. Murdoch: *A First Course in Statistical Programming with R*. Cambridge University Press. New York, 2007.
3. K.G. Srinivasa and G. M. Siddesh: *Statistical Programming in R*, Oxford University Press, New Delhi, 2017.
4. Peter Dalgaard: *Introductory Statistics with R*. Springer, 2nd edition, 2008.
5. Phil Spector: *Data Manipulation with R*. Springer, New York, 2008.
6. Alain F. Zuur, Elena N. Ieno, and Erik Meesters: *A Beginner's Guide to R. Use R.* Springer, 2009.
7. John Verzani, *Using R for Introductory Statistics,* Chapman & Hall/CRC, 2004.

G. Lecture Plan:-

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1,2,3	**General Introduction into the R Ecosystem**: Downloading and installing R, History of R, R packages, CRAN. Introduction to RStudio.	illustrate how to install R	Lecture	2115.1	Home Assignment Class Quiz Mid Term I End Term
4,5,6	Vector, Matrices and Arrays, Factors and Data Frames, Lists, Conditional and Control Flow	Demonstration of various basic variables in R	Lecture	2115.1	Home Assignment Class Quiz Mid Term I End Term
7,8,9	**R Syntax Basics**: Constants, operators, functions, variables, Random numbers	Demonstrate random number generation in R	Lecture	2115.1	Home Assignment Mid Term I End Term
10,11,12	Vectors and vector indexing, simple descriptive stats, Loops, Conditional expressions	Describe the descriptive statistics in R	Lecture	2115.2	In Class Quiz Mid Term I End Term
13,14, 15	**Data Management:** Creating, recoding renaming variables, missing values, sorting, merging.	Describing the basic programming in R	Lecture	2115 .2	Class Quiz Mid Term I End Term
16, 17, 18	Data Interface, CSV files, Excel files	Describing the basic programming in R	Lecture	2115.2	Class Quiz Mid Term I End term
19,20, 21	**Charts and Graphs:** Introduction, Pie Chart, Bar Chart, Box Plot,	Describing the graphical techniques in R	Lecture	2115.2	Home Assignment Class Quiz Mid Term I End Term
22,23,24	Histogram, Line Graph and Scatter Plot.	Describing the graphical techniques in R	Lecture	2115.3	Class Quiz Mid Term II End Term

H. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
2115.1	Interpret and illustrate the concept of Basic and intermediate programming	**2**			**2**			**3**				

	concepts											
2115.2	Modern R workflows with RStudio package		**2**	**3**		**2**						
2115.3	Understand graphical representation of data using R.	2		**3**			**1**					
2115.4	Probability and statistics for data analysis using R		**3**		**2**			**3**				
2115.5	Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.	**2**		**2**			**2**					

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Science

Department of Mathematics & Statistics
Course Hand-out

Introduction to C-Languages | MA 2116 | 2 Credits | 2 0 0 2

Session: Aug – Dec 2020 | Faculty: Dr. Mahesh Kumar Dubey | Class: B.Sc. (Hons) Mathematics III SEM

A. Introduction: This course is offered by Department of Mathematics and Statistics for B.Sc. (Hons.) Mathematics students, targeting students who wish to pursue research & development in industries or higher studies in field of Mathematics and Engineering. The computer is often very handy tool when solving complex technical problems in science and engineering. Programming a computer is a fundamental task in finding solution to such problems. The course aims to provide exposure to problem solving through programming. It aims to train the students to the basic concepts of the C- programming languages. The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also, by learning the basic programming constructs they can easily switch over to any other language in future.

B. Course Outcomes: At the end of the course, students will be able to

[MA 2116.1] Understand the broad perspective about the uses of computers in science and engineering which make them employable.

[MA 2116.2] Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.

[MA 2116.3] Develops the ability to analyze a problem, develop an algorithm to solve it, which enhance their employability skills.

[MA 2116.4] Develops the skills of the C programming language to implement various algorithms and develops the basic concepts and terminology of programming in general.

[MA 2116.5] Understand a defensive programming concept and have ability to handle possible errors during program execution which sharpen their programming skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

The PSO's of B.Sc. in Mathematics programme are:

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

C-Language Preliminaries: General introduction of computers, hardware and software, computer language and programming, introduction of algorithm method, introduction of flow charts, character set, keywords, character constants, 'C' variables, naming the variable, types of variables, declaring variable; Operator and Expressions: Operators , expressions, operators precedence in expressions; Input and Output in C-Programs: Formatted output functions, formatted input functions, unformatted output functions, unformatted input functions, mathematical library; Statements: Conditional Statement, compound Statement, If Statement, If-else Statement; Implementing Loops in C-Programs: Loop, while statement, for loop, nesting of loops, do-while loop; Array Variables and Functions: Defining an array in C-language, multidimensional array, initializing two-dimensional array, sorting of Arrays, syntax rules for function declaration.

F. BOOKS

Text Books:

1. E. Balaguruswamy, *Computing Fundamentals & C Programming*, Tata McGraw Hill, 2008.

2. Y. P. Kanetkar, *Let us C*, 12th Edition, BPB Publication, 2014.
3. Lipschitz, *Programming in C* (Schaum's Series), Tata McGraw Hill, 2003.

Reference Books

1 B. A. Forouzan & R. F. Gilberg, *Computer Science – A structured programming Approach Using C*, Cengage Learning, 2011.
2 E. Balaguruswamy, *Programming in ANSI-C*, Tata McGrawHill, 2011.
3 B. W. Kernighan, D. M. Ritchie, *The C Programing Language*, 2nd Edition, Prentice Hall of India, 2014.

G. Lecture Plan:

Lecture No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers' expectations and understand student expectations	Lecture Interaction	--	N/A
2	General introduction of computers, hardware and software	Describing basic architecture of computer	Lecture	MA2116.1	Quiz/Assignment MTE-I, II, ETE
3	Computer language and programming	Differentiate between machine language and high-level language	Lecture	MA2116.1	Quiz/Assignment MTE-I, II, ETE
4	History of C Languages and introduction	The history of C Languages	Lecture	MA2116.1	Quiz/Assignment MTE-I, II, ETE
5	Introduction of algorithm method	Implementation of formulation of algorithms	Lecture	MA2116.2	Quiz/Assignment MTE-I, II, ETE
6	Introduction of flow charts	Learning the implementation of flow chart	Lecture	MA2116.2	Quiz/Assignment MTE-I, II, ETE
7	Character set, keywords, character constants, C' variables, naming the variable	Describe and implementation of various type of variables	Lecture	MA2116.2	Quiz/Assignment MTE-I, II, ETE
8	types of variables, declaring variable	Describe and implementation of various type of variables	Lecture	MA2116.2	Quiz/Assignment MTE-I, II, ETE
9	Operator and Expressions: Operators precedence in expressions	Implementation of precedence in programming	Lecture	MA2116.2, MA2116.3	Quiz/Assignment MTE-I, II, ETE
FIRST SESSIONAL EXAM					

10	Input and Output in C-Programs	Implementation of input and output statements	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
11	Formatted output functions, formatted input functions	Implementation of input and output statements	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
12	unformatted output functions, unformatted input functions	Implementation of input and output statements	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
13	Mathematical library; Statements: Conditional Statement, compound Statement	Implementation of decision statements	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
14	Constants (integer, real, character, string); variables, keywords)	Describe and implementation of various type of variables & Constant	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
15	If Statement, If-else Statement; Implementing, Decision statements: if, if-else, nested if-else, if-else ladder	Implementation of decision statements	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
16	Loops in C-Programs: Loop, while statement	Learning the implementation of looping	Lecture	MA2116.3, MA2116.4,	Quiz/Assignment MTE-I, II, ETE
17	for loop, nesting of loops, do-while loop	Learning the implementation of looping	Lecture	MA2116.3	Quiz/Assignment MTE-I, II, ETE
SECOND SESSIONAL EXAM					
18	Array Variables and Functions	Describe and define array of various data type	Lecture	MA2116.4, MA2116.5	Quiz/Assignment MTE-I, II, ETE
19	Defining an array in C-language	Describe and define array of various data type	Lecture	MA2116.3, MA2116.4, MA2116.5	Quiz/Assignment MTE-I, II, ETE
20	1-D array: definition, declaration, initialization, input array, output array	Describe and define array of various data type	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
21	1-D character array: character array, string, string standard function	Describe and define array of various data type	Lecture	MA2116.3, MA2116.4	Quiz/Assignment MTE-I, II, ETE
22	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture	MA2116.3, MA2116.4, MA2116.5	Quiz/Assignment MTE-I, II, ETE
23	2-D array: definition, declaration, initialization, input array, output array, one simple program	Describe and define array of various data type	Lecture	MA2116.4, MA2116.3	Quiz/Assignment MTE-I,II, ETE

24	sorting of Arrays	Describe and define array of various data type	Lecture	MA2116.3, MA2116.4, MA2116.5	Quiz/Assignment MTE-I, II, ETE
25	Functions: introduction to functions	Describe and define array of various data type	Lecture	MA2116.3, MA2116.4, MA2116.5	Quiz/Assignment MTE-I, II, ETE
26	syntax rules for function declaration	Describe importance of function and modular programming	Lecture	MA2116.3, MA2116.4, MA2116.5	Quiz/Assignment MTE-I, II, ETE
End Term Exam					

H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes **(POs)**							Correlation with Program Specific Outcomes (**PSOs**)			
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO4**
MA2116.1	Understand the broad perspective about the uses of computers and programming in science and engineering.	**2**						**2**		**2**	**3**	**3**
MA2116.2	Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.	**2**						**2**	**2**			
MA2116.3	Develops the ability to analyse a problem, develop an algorithm to solve it	**2**						**2**			**1**	
MA2116.4	Develops the skills of the C programming language to implement various algorithms and develops the basic concepts and terminology of programming in general.	**2**						**2**	**1**	**1**		**2**
MA2116.5	Understand a defensive programming concept. Ability to handle possible errors during program execution.	**2**						**2**	**1**	**3**	**3**	**3**

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

DISTRIBUTION THEORY | MA2140 | 3 Credits | 2 1 0 3

Session: July 20 – Nov.20 | Faculty: **Dr. Mohd. Rizwanullah** | Class: B.Sc. /B.A. III Sem.

A. Introduction:-

Distribution Theory is concerned with the statistical techniques for identifying the nature of the distribution of the data. It is an important subject and step in all spheres of data analysis. The course aims at providing the basics of distribution theory and limit theorems with emphasis on some commonly encountered distributions like Binomial, Poisson, Normal and Central limit theorem.

B. Course Outcomes: At the end of the course, students will be able to

[1304.1]	Understand the concept of probability Distributions
[1304.2]	Understand conceptual framework of discrete probability distributions and their implementation.
[1304.3]	Understand conceptual framework of continuous probability distributions and their implementation.
[1304.4]	Understand conceptual framework of limit theorems to apply in real life problems that enhance employability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.
PSO.2	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
PSO.3	to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Discrete Probability Distributions: Bernoulli distribution, Binominal distributions, Poisson distribution, Poisson distribution as a limiting case of Binomial distribution, Negative Binominal distribution, Geometric distribution, Hyper-geometric and their properties. **Continuous Probability Distribution:** Uniform distribution, Normal distribution, Exponential distribution, Beta distribution, Gamma distribution, Cauchy distribution and their properties. **Limit Laws:** Convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution, weak law of large numbers (WLLN), strong law of large numbers (SLLN), De-Moivre-Laplace theorem, central limit theorem (C.L.T.) for i.i.d. variates, Liapunov theorem (without proof) and applications of C.L.T..

F. TEXT BOOKS:-

1. Goon, A.M., Gupta, A.K. and Das Gupta, B., Fundamental of Statistics, Vol. I, World Press, Calcutta, 1999.
2. Mood, A.M., Greybill, F.A. and Bose D.C., Introduction to the Theory of Statistics, McGraw Hill, 1974.

G. REFERENCE BOOKS:-

1. Hoel P.G., Introduction to Mathematical Statistics, Asia Publishing House, 1971.
2. Snedecors G.W. and Cochran W.G., Statistical Methods, Iowa State University Press. 1967.
3. Gupta S.C. and Kapoor V.K, Fundamentals of Mathematical statistics, Sultan Chand and Co.,3rd edition, New Delhi, 2008.
4. Goon A.M., Gupta M.K. and Das Gupta B, Fundamental of Statistics, Vol. I, World Press, Calcutta, 1991.
5. Feller, W., An Introduction to Probability Theory and Its Applications, Vol. 1, 3rd Edition, John Wiley,

1968.
6. Mukhopadhyay, P., Mathematical Statistics, Books & Allied (P) Ltd., 2009.

H. Lecture Plan:-

Lect. No.	Description of the syllabus	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Concept of probability**	Introduction of Probability	Lecture	**1304.1**	-
2-3	**Discrete Probability Distributions:** Bernoulli distribution-Definition, Probability Mass function, Properties, Numerical.	To Aquent with prob. distribution	Lecture	**1304.1**	Home Assignment and Class Quiz Mid-Term I End-Term
4-5	Binominal distributions-Definition, Probability Mass function, Properties, Numerical.	To learn pmf and binomial dist	Lecture	**1304.2**	Home Assignment and Class Quiz Mid-Term I End-Term
6-8	Poisson distribution--Definition, Probability Mass function, Properties, Numerical. Poisson distribution as a limiting case of Binomial distribution.	About poisson dist	Lecture	**1304.2**	Home Assignment and Class Quiz Mid-Term I End-Term
9-10	Negative Binominal distribution- Definition, Probability Mass function, Properties, Numerical.	To now negative normal form, its pdf and application	Lecture	**1304.2**	Home Assignment and Class Quiz Mid-Term I End-Term
11-12	Geometric distribution-Definition, Probability Mass function, Properties, Numerical. Memory less property.	About Geometric distribution and its properties	Lecture	**1304.2**	Home Assignment and Class Quiz Mid-Term I End-Term
13-14	Hyper-geometric- Definition, Probability Mass function, Properties, Numerical.	Hypergeometric, its pmf and properties	Lecture	**1304.2**	Home Assignment and Class Quiz Mid-Term I End-Term
15	**Continuous Probability Distribution:** Uniform distribution- Definition, Probability density function, Properties, Numerical.	To know the cont. prob. Distribution	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term

16-18	Normal distribution Definition, Probability density function, Properties, Numerical.	Normal prob. Dist. And its properties	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term
19-21	Exponential distribution - Definition, Probability density function, Properties, Numerical. Memory less property.	Exponoential prob. Dist and memory less properties	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term
22-23	Gamma distribution -Definition, Probability density function, Properties, Numerical.	Gamma dist. Its application	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term
24-25	Beta distribution- Definition, Probability density function, Properties, Numerical.	Beta Dist. And its application	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term
26	Cauchy distribution -Definition, Probability density function, Properties, Numerical.	Cauchy dist and its application	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term
27-29	**Limit Laws:** Convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution,	To know the law of large number	Lecture	**1304.3**	Home Assignment and Class Quiz Mid-Term I End-Term
30-31	Weak law of large numbers (WLLN)	WLLN	Lecture	**1304.4**	Home Assignment and Class Quiz Mid-Term I End-Term
32-33	Strong law of large numbers (SLLN)	SLLN	Lecture	**1304.**	Home Assignment and Class Quiz Mid-Term I End-Term
34-36	De-Moivre-Laplace theorem, central limit theorem (C.L.T.) for i.i.d. variates, Liapunov theorem (without proof) and applications of C.L.T, Numerical on CLT.	Central limit theorem	Lecture	**1304.4**	Home Assignment and Class Quiz Mid-Term I End-Term

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
2140.1	Understand the concept of probability Distributions	2			2			3	1	1	1	1
2140.2	Understand conceptual framework of discrete probability distributions and their implementation.		2	3		2			1	1	2	1
2140.3	Understand conceptual framework of continuous probability distributions and their implementation.	2		3			1		1	2	2	1
2140.4	Understand conceptual framework of limit theorems to apply in real life problems that enhance employability.		3		2			3	1		2	2

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics

Course Hand – Out

SAMPLING THEORY | MA2141 | 3 Credits | 2 1 0 3

Session: August 20 – December 20 | Faculty: **Dr. Monika Saini** | Class: B.Sc. /B.A. III Sem.

A. Introduction:-

Sampling Theory is concerned with the tools and techniques for selecting a sample from the population. It is an important subject and step in all spheres of data analysis. The course aims at providing the basics of sampling techniques with emphasis on some commonly encountered techniques in statistical data analysis such as random sampling, cluster sampling and two-stage sampling.

B. Course Outcomes: At the end of the course, students will be able to

2141.1	Understand the concept of sample and population.
2141.2	Understand conceptual framework of simple random sampling and its implementation.
2141.3	Understand conceptual framework of stratified sampling and its implementation.
2141.4	Understand conceptual framework of systematic sampling and its implementation.
2141.5	Understand conceptual framework of cluster sampling, two-stage sampling, and their implementation to deal with business problems and enhancing employability skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.

[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.
PSO.2	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
PSO.3	to develop creative thinking and the power of imagination.
PSO.4	to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Introduction: Concept of population and sample, need for sampling, complete enumeration versus sampling, basic concepts in sampling, sampling and non-sampling errors, acquaintance with the working (questionnaires, sampling design, methods followed in field investigation, principal findings, etc.) of NSSO and other agencies under taking sample surveys. **Simple Random Sampling with or without replacement:** Estimation of mean, total, variance, proportion, equivalence of different definitions, sample size problem. **Stratified Sampling:** Estimation of mean, total, proportion and optimum allocation, comparison with simple random sampling without replacement, post stratification. **Systematic Sampling Scheme:** Linear and circular systematic sampling, comparison with SRS and stratified sampling schemes, linear trend, simple method of variance. **Cluster Sampling:** Estimation of mean and total, relative efficiency and its estimation, optimum unit of sampling and multipurpose surveys, result on equal and unequal clusters. **Two Stage Sampling:** results on equal and unequal fsu, allocation of sample, comparison with one stage sampling, effect of change in size of fsu.

TEXT BOOKS:-

1. Cochran W.G., Sampling Techniques, John Wiley and Sons, New York, 1977.
2. Sukhtme, P.V., Sukhatme, B.V., Sukhatme, S. and Asok C., Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi, 1984.

REFERENCE BOOKS:-

1. Goon A.M., Gupta M.K. and Das Gupta B., Fundamentals of Statistics, Vol. II, world Press, Calcutta, 1986.
2. Sampath, S., Sampling Theory and Methods, Narosa Publishing House, New Delhi, 2000.
3. Des Raj, Sample Survey Theory, Narosa Publishing House, New Delhi, 2000.
4. Murthy M.N., Sampling Theory and Methods, Statistical Publishing Society, Calcutta, 1967.
5. Kish L, Survey Sampling, John Wiley and Sons, New York, 1967.
6. Hansen M.H., Hurwitz W.N. and Madow W.G., Sample Survey Method and Theory, Vol. II, New York and London, Wiley Publication, 1975.

F. Lecture Plan:-

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Introduction:** Concept of population and sample, need for sampling, complete enumeration versus sampling.	collect appropriate data from the field for the empirical study	Lecture	2141.1	Home Assignment Class Quiz Mid Term 1 End Term
2,3	Basic concepts in sampling, sampling and non-sampling errors.	collect appropriate data from the field for the empirical study	Lecture	2141.1	Home Assignment Class Quiz Mid Term 1 End Term
4,5	Acquaintance with the working (questionnaires, sampling design, methods followed in field investigation, principal findings, etc.) of NSSO and other agencies under taking sample surveys.	collect appropriate data from the field for the empirical study	Lecture	2141.1	In Class Quiz Mid Term 1 End Term
6,7	Class Test-I				
8,9	**Simple Random Sampling with replacement:** Estimation of mean, total, variance, proportion, equivalence of different definitions, sample size problem.	Demonstration on sample selection using SRSWR	Lecture	2141.2	Class Quiz Mid Term I End Term
10, 11	**Simple Random Sampling without replacement:** Estimation of mean, total, variance, proportion, equivalence of different definitions, sample size problem.	Demonstration on sample selection using SRSWOR	Lecture	2141.2	Class Quiz Mid Term 1 End term
12	**Class Test-II**				
13,14	**Stratified Sampling:** Estimation of mean, total, proportion and optimum allocation.	Demonstration on sample selection using Stratified sampling	Lecture	2141.3	Class Quiz Mid Term I End Term
15,16	Comparison with simple random sampling without replacement.	Demonstration on sample selection using Stratified sampling	Lecture	2141.3	Class Quiz Mid Term I End Term

17,18	Post stratification.	Demonstration on sample selection using Stratified sampling	Lecture, Activity	2141.3	Class Quiz End Term Mid Term I
19,20	Class test-III				
21,22	**Systematic Sampling Scheme:** Linear and circular systematic sampling..	Demonstration on sample selection using Systematic sampling	Lecture	2141.4	Class Quiz Mid Term II End Term
23,24	Comparison with SRS and stratified sampling schemes, linear trend, simple method of variance	Demonstration on sample selection using Systematic sampling	Lecture	2141.4	Class Quiz Mid Term II End Term
25,26	Class Test-IV				
27,28	**Cluster Sampling:** Estimation of mean and total, relative efficiency and its estimation.	Demonstration on sample selection using cluster sampling	Lecture	2141.5	Class Quiz Mid Term II End Term
29	Optimum unit of sampling and multipurpose surveys, result on equal and unequal clusters.	Demonstration on sample selection using cluster sampling	Lecture	2141.5	Class Quiz Mid Term II End Term
30	Class Test-V				
31	**Two Stage Sampling:** results on equal and unequal fsu, allocation of sample.	Demonstration on sample selection using two stage sampling	Lecture	2141.5	Class Quiz Mid Term II End Term
32,33	Comparison with one stage sampling	Demonstration on sample selection using two stage sampling	Lecture	2141.5	Class Quiz End Term
34, 35,36	effect of change in size of fsu.	Demonstration on sample selection using two stage sampling	Lecture	2141.5	Class Quiz End Term

G. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA2141.1	Understand the concept of sample and population.	**3**			**2**			**3**				
MA2141.2	Understand conceptual framework of simple random sampling and its implementation.		**2**	**3**		**2**						
MA2141.3	Understand conceptual framework of stratified sampling and its implementation	2		**3**			**2**					
MA2141.4	Understand conceptual framework of systematic sampling and its implementation		**3**		**2**			**3**				
MA2141.5	Understand conceptual framework of cluster sampling, two-stage sampling, and their implementation to deal with business problems and better decision making.	**2**		**2**		**2**	**2**					

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

DEPARTMENT OF MATHEMATICS & STATISTICS

Course Hand-Out

Multivariate Calculus | MA2211 | 4 Credits | 3 1 0 4

Session: Jan 21 - May 21 | Faculty: Dr. Vivek Singh | Class: B.SC. Mathematics (HONS) IV SEM

A. Introduction: This course is offered by Dept. of Mathematics & Statistics, Mathematics graduates are in demand for their highly developed analytical skills and capacity to apply their knowledge to a wide range of problems relevant to modern industry. This course is a carefully selected blend of theory and practical, real-world applications which prepares for specialist professional employment. Studying mathematics is fun and interesting and there is a real satisfaction gained from solving a challenging mathematical problem or mastering a deep mathematical theory. It gives the strongest mathematical foundations, and the greatest flexibility to specialize within mathematics, according to one' interests and aspirations. This course is important to students whom majors are mathematics as it is the first step for them to be familiar with abstract topics in calculus; mainly limit, continuity and differentiability, differential calculus, partial differentiation and integral calculus. Calculus is also an ideal capstone course for those who will go on to take postgraduate courses in mathematics.

B. Course Outcomes: At the end of the course, students will be able to

[2211.1]. Define the basic concepts and principles of differential calculus, limit, continuity, differentiability.

[2211.2]. Describe the concepts of Partial Differentiation and apply their concepts to evaluate the solutions of related problems.

[2211.3]. Students will get an awareness of phenomena involving continuous change of variables

[2211.4]. Develop the learning skill in solving two and higher order partial derivative problems.

[2211.5]. Describe the concept of multiple integrals and their application in Surface area and Volume evaluation which will enhance the analytical skill to become employable in the relevant field.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. To understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2]. To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics.

[PSO.3]. To develop creative thinking and the power of imagination.

[PSO.4]. To expose the graduates in research in academia and industry for broader applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Limit, Continuity of Function of Several Variables and Partial Derivatives: Introduction to function of several variables, limit of function of several variables, iterated limits, limit and path, continuity of function of several variables; **Differentiability of Function of Several Variables:** directional derivatives, Introduction to partial derivatives, notations and geometric interpretation, higher order partial derivatives and problems, differentiability of function of two variables, theorems on differentiability conditions, chain rules for differentiability, derivatives of implicit functions, homogeneous functions, Euler's theorem for homogeneous functions of n-variables, Extreme values of functions of two variables, Lagrange's method of undetermined multipliers; **Multiple Integrals:** Double integration over rectangular region and nonrectangular region, double integrals

in polar co-ordinates, triple integrals, Volume by triple integrals, cylindrical and spherical co-ordinates, change of variables in double integrals and triple integrals.

F. References:

1. S. Narayan & P.K. Mittal, Differential Calculus, S. Chand Publication, New Delhi, 2011.
2. T. M. Apostol, Advanced Calculus Volume II, Wiley India Publication, Delhi, 2007.
3. S. R. Ghorpade & B. V. Limaye, A course in Multivariable Calculus & Analysis, Springer India, 2014.
4. David V. Widder, Calculus, PHI, New Delhi, India, 2012.
5. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus, Dorling Kindersley Pvt.Ltd., New Delhi, 2007.

G. Lecture Plan:

Lecture Number	Topic	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing CO
1	Introduction of the Course	Develop the understanding about the course	Lecture, Discussion & Examples	NA	NA
2, 3	Limit	Develop the understanding about Limit	Lecture, Discussion & Examples	2211.1	Quiz, Sessional & End Term Exam.
4, 5	Continuity	Develop the understanding about Continuity	Lecture, Discussion & Examples	2211.1	Quiz, Sessional & End Term Exam.
6	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.1	Quiz, Sessional & End Term Exam.
7	Introduction to function of several variables	Learn to find derivatives	Lecture, Discussion & Examples	2211.2	Quiz, Sessional & End Term Exam.
7	limit of function of several variables	Learn to find limit of function of several variables	Lecture, Discussion & Examples	2211.2	Quiz, Sessional & End Term Exam.
8	iterated limits	Learn to find iterated limits	Lecture, Discussion & Examples	2211.2	Quiz, Sessional & End Term Exam.
9	limit and path	Learn to find limit and path	Lecture, Discussion & Examples	2211.2	Quiz, Sessional & End Term Exam.
10	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.2	Quiz, Sessional & End Term Exam.
11, 12	continuity of function of several variables	Learn to find continuity	Lecture, Discussion & Examples	2211.2	Quiz, Sessional & End Term Exam.
13	discontinuity of function of several variables	Learn to find discontinuity		2211.2	
14, 15	Differentiability of Function of Several Variables	Learn to find differentiability	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
16	Introduction to partial derivatives	Learn to find partial derivatives	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
17	notations and geometric interpretation	Learn geometric interpretation of partial derivatives	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
18, 19	higher order partial derivatives and problems	Learn to find higher order partial derivatives	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.

20	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
21	directional derivatives	Learn to find directional derivatives	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
22	differentiability of function of two variables	Learn to find differentiability of function of two variables	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
23	theorems on differentiability conditions		Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
24	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
25	derivatives of implicit functions	Solve problems of implicit functions	Lecture, Discussion & Examples	2211.3	Quiz, Sessional & End Term Exam.
26	Differentiation of composite functions.	Solve problems of composite functions		2211.3	
27	homogeneous functions	Understand the concept of homogeneous functions	Lecture, Discussion & Examples	2211.4	Quiz, Sessional & End Term Exam.
28	Euler's theorem	Apply the concept of derivatives	Lecture, Discussion & Examples	2211.4	Quiz, Sessional & End Term Exam.
29	total derivative	Learn to find total derivative		2211.4	
30	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.4	Quiz, Sessional & End Term Exam.
31, 32	Extreme values of functions of two variables	Understand the concept of Extreme values of functions for two variables	Lecture, Discussion & Examples	2211.4	Quiz, Sessional & End Term Exam.
33, 34	Lagrange's method of undetermined multipliers	Understand the concept of Lagrange's method of undetermined multipliers	Lecture, Discussion & Examples	2211.4	Quiz, Sessional & End Term Exam.
35	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.4	Quiz, Sessional & End Term Exam.
36	Double integration over rectangular region	Illustrate concept of area	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
37	Double integration over nonrectangular region	Illustrate concept of area	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
38	double integrals in polar co-ordinates	Illustrate concept of area	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
39	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
40, 41	triple integrals	Illustrate concept of area and volume	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
42	Volume by triple integrals	Illustrate concept of volume	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
43	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
44, 45	cylindrical co-ordinates	Apply concept of integration to find surface and volume of curves	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.

45, 46	spherical co-ordinates	Apply concept of integration to find surface and volume of curves	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
47	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
48	change of variables in double integrals	Understand to use concept of change of variable	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
49	change of variables in triple integrals	Understand to use concept of change of variable	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.
50	Tutorial-Problem Solving Session	Apply the concepts in real world problems	Lecture, Discussion & Examples	2211.5	Quiz, Sessional & End Term Exam.

H. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA2211.1	Define the basic concepts and principles of differential calculus, limit, continuity, differentiability.	3		1				2	3	2	3	3
MA2211.2	Describe the concepts of Partial Differentiation and apply their concepts to evaluate the solutions of related problems.	3		2			1	2	3	3	3	3
MA2211.3	Students will get an awareness of phenomena involving continuous change of variables	3		1				2	3	3	3	3
MA2211.4	Develop the learning skill in solving two and higher order partial derivative problems.	3					1	2	2	2	2	3
MA2211.5	Describe the concept of multiple integrals and their application in Surface area and Volume evaluation which will enhance the analytical skill to become employable in the relevant field.	3						2	2	2	3	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics

Course Hand-out

PDE and System of ODE | MA2212| 4 Credits | 3 1 0 4

Session: Jan – June 2021 | Faculty: Dr. Alok Bhargava | Class: B. Sc. (Hons) Mathematics IV Sem

A. Introduction: This course is offered by Dept. of Mathematics as a core subject, targeting students who wish to pursue research or higher studies in the field of partial differential equations. Students are expected to have knowledge of basic differential functions, complex functions, analyticity, singularity, and integration for a better learning.

Course Objectives: At the end of the course, students will be able to

[2212.1] Describe the concept of Partial differential equations, their formation and categorization.

[2212.2] Describe the concept of solution of Partial differential equations with constant coefficients which enhance their problem-solving skills and make them employable.

[2212.3] Describe the concept of solution of Partial differential equations with variable coefficients which enhance their problem-solving skills.

[2212.4] Describe the system of Ordinary Differential Equations and obtain the solution.

B. Program Outcomes and Program Specific Outcomes

PO1. **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100

D. Syllabus

MA2212: PARTIAL DIFFERENTIAL EQUATIONS & SYSTEM OF ODE [3 1 0 4]

Partial Differential Equations: Formation, order & degree, linear and non-linear partial differential equations of the first order, complete solution, singular solution, general solution, solution of Lagrange's linear equations, charpit's general method of solution; Linear Partial Differential Equations of Second and Higher Orders: Linear and non-linear homogeneous and non-homogeneous equations with constant coefficients, partial differential equation with variable coefficients reducible to equations with constant coefficients, their complimentary functions and particular integrals, equations reducible to linear equations with constant coefficients. classification of linear partial differential equations of second order, hyperbolic, parabolic and elliptic types, reduction of second order linear partial differential equations to canonical (normal) forms and their solutions, solution of linear hyperbolic equations, Monge's method for partial differential equations of second order. Cauchy's problem for second order partial differential equations, characteristic equations and characteristic curves of second order partial differential equation, method of separation of variables; Systems of Linear Differential Equations: Types of linear systems, differential operators, an operator method for linear systems with constant coefficients, basic theory of linear systems in normal form, homogeneous linear systems with constant coefficients, two equations in two unknown functions, the method of successive approximations.

References:

1. D. A. Murray, Introductory Course on Differential Equations, Orient Longman, 2005.
2. M. D. Raisinghania, Ordinary and Partial differential equations, S. Chand, India, 2018.
3. Frank Ayres, Theory and Problems of Differential Equations, McGraw Hill Book Company, 1972.
4. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd.
5. I. N. Sneddon, Elements of Partial Differential Equations, Tata McGraw Hill Book Company, 1998.
6. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 2016.
7. S. L. Ross, Differential equations, 3rd edition, John Wiley and Sons, India,2004

E. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to course		Lecture		
2-3	Partial Differential Equations (PDE): Formation, order & degree	Basic Knowledge of PDE and its formation	Lecture	2212.1	Mid Term, Quiz, Assignment, End term
4	linear partial differential equations of the first order, complete solution, singular solution, general solution, Lagrange's equation	Basic Knowledge of solution of PDE of first order.	Lecture	2212.1	Mid Term, Quiz, Assignment, End term
5-8	solution of Lagrange's linear equations, Standard forms	Knowledge of solution of Lagrange's linear equations	Lecture	2212.1	Mid Term, Quiz, Assignment,

					End term
9-10	non-linear partial differential equations of the first order, Charpit's general method of solution	Knowledge of solution of linear PDE by Charpit's Method	Lecture	2212.1	Mid Term, Quiz, Assignment, End term
11-13	Homogeneous Linear Partial Differential Equations with constant coefficients	Knowledge of solution of Homogeneous linear PDE with constant coefficients	Lecture	2212.2	Mid Term, Quiz, Assignment, End term
14-16	Non-Homogeneous Linear Partial Differential Equations with constant coefficients	Knowledge of solution of Non-Homogeneous linear PDE with constant coefficients	Lecture	2212.2	Mid Term, Quiz, Assignment, End term
17	partial differential equation with variable coefficients	Basic Knowledge of PDE and their solutions	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
18	Classification of PDE	Basic concept of classification of PDEs	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
19	reduction of second order linear partial differential equations to canonical (normal) forms and their solutions	Basic Knowledge of reduction of second order linear PDE to canonical (normal) forms and their solutions	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
20	Reduction of Hyperbolic equation to its canonical form	Knowledge of reduction of Hyperbolic PDE to canonical (normal) form and their solutions	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
21	Reduction of Parabolic equation to its canonical form	Knowledge of reduction of Parabolic PDE to canonical (normal) form and their solutions	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
22	Reduction of Elliptic equation to its canonical form	Knowledge of reduction of Elliptic PDE to canonical (normal) form and their solutions	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
23-25	solution of linear hyperbolic equations	Knowledge of solution of linear hyperbolic equations	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
26-32	Monge's method for partial differential equations of second order	Application of Monge's method to solve PDE	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
33-34	Cauchy's problem for second order partial differential equations, characteristic equations, and characteristic curves of second order partial differential equation	Basic Knowledge of characteristic equations and characteristic curves	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
35-37	Separation of variables method	Understanding of Separation of variables method to solve PDE	Lecture	2212.3	Mid Term, Quiz, Assignment, End term
38	Systems of Linear Differential Equations: Types of linear systems	Understanding of system of linear ODE and their types	Lecture	2212.4	Mid Term, Quiz, Assignment, End term
39	differential operators,	Understanding of differential operators	Lecture	2212.4	Mid Term, Quiz, Assignment, End term

40-41	Operator method for linear systems with constant coefficients,	Understanding of Operator method for linear systems with constant coefficients	Lecture	2212.4	Mid Term, Quiz, Assignment, End term
42	basic theory of linear systems in normal form,	Understanding of theory of linear systems in normal form	Lecture	2212.4	Mid Term, Quiz, Assignment, End term
43-45	homogeneous linear systems with constant coefficients	Understanding of concept of homogeneous linear systems with constant coefficients and their solution	Lecture	2212.4	Mid Term, Quiz, Assignment, End term
46	Two equations in two unknown functions,	Understanding of Two equations in two unknown functions and their solution	Lecture	2212.4	Mid Term, Quiz, Assignment, End term
47-48	Method of successive approximations	Understanding of Method of successive approximations	Lecture	2212.4	Mid Term, Quiz, Assignment, End term

F. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
1602.1	Describe the concept of Partial differential equations, their formation and categorization.	1						1	3	3	2	3
1602.2	Describe the concept of solution of Partial differential equations with constant coefficients which enhance their problem-solving skills and make them employable.	1						1	3	3	2	3
1602.3	Describe the concept of solution of Partial differential equations with variable coefficients which enhance their problem-solving skills.	1						1	3	3	2	3
1602.4	Describe the system of Ordinary Differential Equations and obtain the solution.	1						1	3	3	2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand-out

Linear Algebra| MA 2213 | 4 Credits | 4 0 0 4

Session: Feb. 2021 – May.2021 | Class: B.Sc. (Hons.) Mathematics | Course Coordinator: Dr. Ashok Kumar Pal

A. Introduction: Dept. of Mathematics & Statistics offer the course Linear Algebra for B.Sc. Hon. Mathematics Students. The aim of this course to motivate students to develop research ability in students by theoretical approach and create interest in pure mathematics. The course will develop a depth understanding of linear Algebra by some concept of Vector space, subspace, linear transformation and matrices. The course will develop mental ability in problem solving.

B. Course Outcomes: At the end of the course, students will be able to

[MA2213.1] Describe the concept of vector space, subspace and basis sets.
[MA2213.2] Describe the concept of linear transformation on vector spaces.
[MA2213.3] Describe the concept of Matrices with their rank, eigen vales and eigen vectors.
[MA2213.4] Describe the concept of Representation of Transformations by Matrices, which enhance their problem-solving skills.
[MA2213.5] Evaluate the solution of mathematical problem, which make them employable.

C. Program Outcomes and Program Specific Outcomes

[PO.1]. **Critical thinking:** Critically interpret data, write reports and apply the basics of evidence.
[PO.2]. **Effective Communication:** Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO.4]. **Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering**.**
[PO.5]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities.
[PO.6]. **Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
[PO.7]. **Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

PROGRAM SPECIFIC OUTCOMES:

[PSO.1]. To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2]. To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics.
[PSO.3]. To develop creative thinking and the power of imagination
[PSO.4]. To expose the graduates in research in academia and industry for broader applications.

D. Assessment Rubrics:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	Quizzes and Assignment	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100

Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.
Quizzes	3 Quizzes (Close Book)

E. Syllabus

Vector spaces: Subspaces, linear dependence, independence, linear span and basis, dimension of a vector space; **Linear Transformations:** definition, some results on linear operator, different types of transformations, rank and nullity, singular and non-singular transformations, inverse linear transformation, isomorphism between vector spaces, linear mapping, composition of linear maps;

Matrices: Symmetric, skew symmetric matrices, hermitian and skew hermitian matrices, row and column matrices, elementary operations on matrices, rank of a matrix; eigen values, eigen vectors and the characteristic equation of a matrix, Cayley Hamilton theorem and its application in finding inverse of a matrix, applications of matrices to a system of linear equations (both homogeneous and non-homogeneous), theorems on consistency of a system of linear equations;

Representation of Transformations by Matrices: Introduction, determination of linear transformation for a given matrix and bases, matrix identity and zero transformations, linear operations on $M_{m\times n}$, matrix of the composition of linear transformations, polynomials of a linear transformation, rank and nullity of matrix, range of a matrix, kernel of a matrix, matrix of change of basis.

References:

1. K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2007.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, First course in Linear Algebra, New Age International Ltd, 2012.
3. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice Hall, Englewood Cliffs, New Jersey, 2014.
4. S. Kumaresan, Linear Algebra-A geometric approach, Prentice Hall of India, 2000.
5. R. B. Dash and D. K. Dalai, Fundamentals of Linear Algebra, Himalaya Publishing house, 2008.
6. Serge Lang, Linear Algebra, 3rd edition, Springer-Verlag, New York 2005.

G. Lecture Plan:

Lec No	Topics	Session Objective	Mode of Delivery (Online/Classroom)	Corresponding CO	Mode of Assessing the Outcome
1	Introduction, aims and objectives of the course and elementary fundamentals of Linear Algebra	Know the basics of the course and understand its applications	Lecture Online	MA2212.1	Assignments Class Quiz Mid-Term I End-Term
2	Vector spaces: Subspaces	Discuss the Vector spaces: Subspaces.	Lecture Online	MA2213.1	
3	linear dependence, independence	Understand the linear dependence, independence	Lecture Online	MA2213.1	
4	linear span and basis, dimension of a vector space	Understand the spanning set.	Lecture Online	MA2213.1	
5	Linear Transformations: definition	Know the basics of the linear transformations	Lecture Online	MA2213.2	
6	some results on linear operator	Know the basics of the linear transformations	Lecture Online	MA2213.2	
7	different types of transformations	Understand the different types of transformations	Lecture Online	MA2113.2	
8	rank and nullity of Linear Transformation	Understand the concept of rank and nullity of Linear Transformation.	Lecture Online	MA2113.2	
9	singular and non-singular transformations	Know the concept of singular and non-singular transformations	Lecture Online	MA2113.2	
10	inverse linear transformation, isomorphism between vector spaces,	Know the concept of inverse linear transformation, isomorphism between vector spaces	Lecture Online	MA2213.2	
11	linear mapping, composition of linear maps	To understand the problem.	Lecture Online	MA2213.2	
12	Discussion of the problems	To understand the problem.	Lecture Online	MA2213.2	
13	Matrices: Symmetric, skew symmetric matrices	Know the concept of Matrices:	Lecture Online	MA2213.2	
14	hermitian and skew hermitian matrices	Know the basics of the hermitian and skew hermitian matrices	Lecture Online	MA2213.2	
15	row and column matrices,	Know the basics of the row and column matrices,	Lecture Online	MA2213.3	

16	Discussion of the problems	To understand the problem.	Lecture Online	MA2213.3	
17	elementary operations on matrices, rank of a matrix;	Know the concept of elementary operations	Lecture Online	MA2213.3	
18	eigen values, eigen vectors and the characteristic equation of a matrix,	Know the basics of eigen values, eigen vectors and the characteristic equation of a matrix	Lecture Online	MA2213.3	
19	Cayley Hamilton theorem and its application in finding inverse of a matrix,	Know the concept of Cayley Hamilton theorem.	Lecture Online	MA2213.3	
20	applications of matrices to a system of linear equations (both homogeneous and non-homogeneous),	Know the concept of applications of matrices to a system of linear equations (both homogeneous and non-homogeneous),	Lecture Online	MA2213.3	
21	Discussion of the problems	To understand the problem.	Lecture Online	MA2213.3	
22	theorems on consistency of a system of linear equations;	Know the concept of theorems on consistency of a system of linear equations	Lecture Online	MA2213.3	
23	Representation of Transformations by Matrices: Introduction, determination of linear transformation for a given matrix and bases,	Know the concept of Representation of Transformations by Matrices: Introduction, determination of linear transformation for a given matrix and bases	Lecture Online	MA2213.3	Assignments Class Quiz Mid-Term II End-Term
24	matrix identity and zero transformations,	Know the concept of matrix identity and zero transformations	Lecture Online	MA2213.3	
25	Discussion more about theorems	Know the concept matrices	Lecture Online	MA2213.3	
26	Discussion of the problems	To understand the problem.	Lecture Online	MA2213.3	
27	linear operations on Mm×n, matrix of the composition of linear transformations,	Understand the linear operations on Mm×n	Lecture Online	MA2213.3	
28	polynomials of a linear transformation,	Understand the concept of polynomials of a linear transformation.	Lecture Online	MA2213.3	
29	rank and nullity of matrix,	Understand the concept of rank and nullity of matrix.	Lecture Online	MA2213.3	
30	Discussion of the problems	To understand the problem.	Lecture Online	MA2213.3	
31	Discussion more about Rank and Nullity of Matrix.	To understand the problem.	Lecture Online	MA2113.4	

32	range of a matrix,	Understand the concept of subsequences.	Lecture Online	MA2113.4	
32	Discussion of the problems	To understand the problem.	Lecture Online	MA2113.4	
33	kernel of a matrix, matrix of change of basis.	To understand the problem.	Lecture Online	MA2113.4	
34	kernel of a matrix, matrix of change of basis.	To understand the problem.	Lecture Online	MA2113.4	
35	Discussion of the problems	To understand the problem.	Lecture Online	MA2113.4	
36	Discussion of rank and nullity with example	To understand the problem.	Lecture Online	MA2113.4	
37	Transformations by Matrices: Rank	To understand the problem.	Lecture Online	MA2113.4	
38	Transformations by Matrices: Nullity	To understand the problem.	Lecture Online	MA2113.4	Assignments Class Quiz End-Term
39	Some Theorems on Rank and Nullity	To understand the problem.	Lecture Online	MA2113.4	
40	Singular and non-singular Operator	To understand the problem.	Lecture Online	MA2113.4 MA2113.5	
41	kernel of a matrix, matrix of change of basis.	To understand the problem.	Lecture Online	MA2113.4	
42	Doubt class	To understand the problem.	Lecture Online	MA2113.4 MA2113.5	
43	Doubt Class	To understand the problem.	Lecture Online	MA2113.4	
44	linear operations on Mm×n, matrix	To understand the problem.	Lecture Online	MA2113.4	
45	Doubt class	To understand the problem.	Lecture Online	MA2113.4 MA2113.5	
46	Matrix of the composition of linear transformations,	Know the concept of Matrix of the composition of linear transformations	Lecture Online	MA2113.4	
47	Doubt class	Know the concept of Matrix of the composition of linear transformations	Lecture Online	MA2113.5	
48	Doubt Class	Know the concept of Matrix of the composition of linear transformations	Lecture Online	MA2113.5	

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
MA2213.1	Describe the concept of vector space, subspace and basis sets	1												2	3	3	2
MA2213.2	Describe the concept of linear transformation on vector spaces.	1												3	2		2
MA2213.3	Describe the concept of Matrices with their rank, eigen vales and eigen vectors.	1			2									2	2	2	2
MA2213.4	Describe the concept of Representation of Transformations by Matrices, which enhance their problem-solving skills.	1			2									3	1		2
MA2213.5	Evaluate the solution of mathematical problem, which make them employable.	1												1	1	2	2

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics and Statistics
Course Hand-out

Vector Calculus and Statics | MA2214| 4 Credits | 3 1 0 4

Session: Feb. 2020 – May 2020 | Faculty: Dr. Sunil Joshi | Class: B.Sc. IV Sem.

Introduction: This course is offered by Dept. of Mathematics and Statistics for Mathematics (Hons.) students, targeting students who wish to pursue research & development in industries or higher studies in field of Mathematics and Engineering. Offers in depth knowledge of Vector Calculus and Statics, Vector differentiation; Gradient; Divergence and curl; Directional derivatives; Laplacian operator. Vector integration; Conservative fields. Theorems of Green, Gauss, Stokes, Develop an understanding of the principles of statics and dynamics, and the ability to analyse problems in a systematic and logical manner, including the ability to draw free-body diagrams. Ability to analyse the statics of trusses, frames and machine and the dynamics of particles, systems of particles and rigid bodies.

Course Outcomes: At the end of the course, students will be able to

[2214.1] Describe the basic concepts of vector Algebra and basic operations on vectors.

[2214.2] Describe the geometric applications of vectors in various domains.

[2214.3] Describe the concept of vector calculus and apply them to solve the problems of real world, which enhances their problem-solving skills and make them employable.

[2214.4] Describe the basic concepts of Statics and evaluate the equilibrium position of particle in different situations, which enhances their problem-solving skills.

[2214.5] Describe the concepts of system of forces in space under different conditions.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

The PSO's of B.Sc in Mathematics programme are :

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D.**Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	20
	Sessional Exam II (Open Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Close Book)	40
	Total	100

Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.

E. SYLLABUS

Vector algebra**:** Addition; Scalar multiplication; Scalar products; Vector product; Scalar and vector triple products; Product of four vectors; Reciprocal vectors; Geometrical applications: Vector equations of lines and planes; Parametric representation of a curve; The circle and other conic sections; Notions of a vector function of a single variable. Vector calculus**:** Vector differentiation; Total differential; Gradient; Divergence and curl; Directional derivatives; Laplacian operator. Vector integration: Path, line, surface and volume integrals; Line integrals of linear differential forms; Integration of total differentials; Conservative fields; Conditions for line integrals to depend only on the end-points; The fundamental theorem on exact differentials; Theorems of green, Gauss, Stokes, and problems based on these. Statics**:** Forces; Couples; Co-planar forces; A static equilibrium; Friction; Equilibrium of a particle on a rough curve; Virtual work; Catenary; Forces in three dimensions; Reduction of a system of forces in space; Invariance of the system; General conditions of equilibrium; Centre of gravity for different bodies; Stable and unstable equilibrium.

F. Text Books:

1. A.R. Vasishtha, Text Book on Vectors, Krishna Prakashan, Meerut, U.P., India, 2014.
2. Shanti Narayan and P. K. Mittal, A Text Book of Vector Calculus, S. Chand & Company Pvt. Ltd, New Delhi, 2009.

G. Reference Books:

1. J. E. Marsden and A. Tromba, Vector Calculus, 5th Edition, W. H. Freeman, 2003.
2. E. Kreyszig, Advanced Engineering Mathematics, 8th Edition, Wiley India Pvt. Ltd., 2010.
3. T. Apostal, Calculus, Vol. I&II, 2nd Edition, Wiley Students Edition, India, 2012.

H. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Introduction and Course Hand-out briefing of Vector algebra	Understanding the basics of vector algebra	Lecture	M2214.1	MTE-I Assignment & Quiz Test ETE
2- 3	Addition; Scalar multiplication; Scalar products	Discuss basic operations of vector calculus	Lecture	M2214.1	MTE-I Assignment & Quiz Test ETE
4-5	Vector product; Scalar and vector triple products	Describe vector product	Lecture	M2214.1	MTE-I Assignment & Quiz Test ETE
6-7	Product of four vectors; Reciprocal vectors	Describe vector product	Lecture	M2214.1	MTE-I Assignment & Quiz Test ETE
8-9	Geometrical applications, Vector equations of lines and planes	Discuss Application and vector Equations	Lecture	M2214.1	MTE-I Assignment & Quiz Test ETE
10-11	Parametric representation of a curve; The circle and other conic sections	Discuss Parametric representation	Lecture	M2214.2	MTE-I Assignment & Quiz Test ETE
12	Notions of a vector function of a single variable	Discuss notation of vector function	Lecture	M2214.2	MTE-I Assignment & Quiz Test ETE
13-14	Vector calculus**:** Vector differentiation	Explain Differentiation of vectors	Lecture	M2214.2	MTE-I Assignment & Quiz Test

					ETE
15	Total differential	Explain total differentiation of vectors	Lecture	M2214.2	MTE-I Assignment & Quiz Test ETE
16-17	Gradient	Describe Gradient and properties	Lecture	M2214.2	MTE-I Assignment & Quiz Test ETE
18-19	Divergence	Describe Divergence and properties	Lecture	M2214.2	MTE-I Assignment & Quiz Test ETE
20-21	Curl	Describe Curl and properties	Lecture	M2214.2	MTE-I Assignment & Quiz Test ETE
2223-	Directional derivatives; Laplacian operator.	Describe Directional derivatives and properties	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE
24	Vector integration: Path, line, surface and volume integrals	Explain Vector integration	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE
25	Line integrals of linear differential forms	Explain line integration	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE
26	Integration of total differentials	Discuss Integration of total differentials	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE

27-28	Conservative fields; Conditions for line integrals to depend only on the end-points	Describe properties for line integrals	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE
29	The fundamental theorem on exact differentials	Explain fundamental theorem on exact differentials	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE
30-34	Theorems of green, Gauss, Stokes, and problems based on these	Explain fundamental theorems	Lecture	M2214.3	MTE-2 Assignment & Quiz Test ETE
35	Introduction to Statics	Understanding the basics of Statics	Lecture	M2214.4	MTE-2 Assignment & Quiz Test ETE
36	Forces; Couples	Discuss Forces and couples	Lecture	M2214.4	MTE-2 Assignment & Quiz Test ETE
37	Co-planar forces	Discuss Co-planar forces and properties	Lecture	M2214.4	MTE-2 Assignment & Quiz Test ETE
38	A static equilibrium; Friction	Discuss static equilibrium; Friction	Lecture	M2214.4	MTE-2 Assignment & Quiz Test ETE
39	Equilibrium of a particle on a rough curve	Discuss equilibrium	Lecture	M2214.4	Assignment ETE
40-41	Virtual work; Catenary	Describe Virtual work , Catenary	Lecture	M2214.5	Assignment ETE

42-43	Forces in three dimensions; Reduction of a system of forces in space	Explain Forces in three dimension and in space	Lecture	M2214.5	Assignment ETE
44	Invariance of the system	Discuss Invariance of the system	Lecture	M2214.5	Assignment ETE
45	General conditions of equilibrium	Discuss General conditions of equilibrium	Lecture	M2214.5	Assignment ETE
46- 47	Centre of gravity for different bodies	Explain Centre of gravity for different bodies	Lecture	M2214.5	Assignment ETE
48	Stable and unstable equilibrium.	Explain Stable and unstable equilibrium.	Lecture	M2214.5	Assignment ETE

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	**STATEMENT**	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 2214.1	Understand the basic concepts to understand and find the magnitude, direction and component form of displacement vectors.	3										
MA2214.2	Students will be able to develop skill to perform the following vector operations: – addition and subtraction, – scalar multiplication, – dot product, geometric and component forms, – cross product, geometric and component forms.		2	2								

MA2214.3	Use vector models for applications of velocity, force, work, finding angles between vectors, and projections. Recognize, construct, and interpret equations of planes from tables, contour lines				2	2						
MA 2214.4	A skill is developed to construct free-body diagrams and to calculate the reactions necessary to ensure static equilibrium. An understanding of the analysis of distributed loads. A knowledge of internal forces and moments in members.						2				2	
MA2214.5	An ability to calculate centroids and moments of inertia. A knowledge of kinematic and kinetic analyses and energy and momentum methods for particles and systems of particles. A knowledge of kinematic and kinetic analyses and energy and momentum methods for rigid bodies.			1					2			

1- Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

DEPARTMENT OF Mathematics & Statistics

Course Hand-out

Mathematical Modeling | MA2215| 4 Credits | 3 1 0 4

Session: Feb 21-June 21 | Faculty: Dr. Mahesh Kumar Dubey | Class: B.Sc. Mathematics (HONS) IV SEM

A. **Introduction:** This course is offered by Dept. of Mathematics & Statistics, targeting students who wish to pursue research & development in applied mathematics field. This course is an introduction to mathematical modeling based on differential equations, optimization modeling and queuing model. The main objective will be to learn how to take a phenomenon arising in physics, chemistry, biology, even the social sciences, then study it (intelligently) using mathematics. This can be a very tricky endeavour: it necessitates both a sound understanding of the field where the problem originated, and a capacity for sometimes quite sophisticated mathematical analysis. The focus of the course will be on seeking the connections between mathematics and physical systems, studying and applying various modeling techniques to creating mathematical description of these systems, and using this analysis to make predictions about the system's behaviour.

B. **Course Outcomes:** At the end of the course, students will be able to:

[MA 2215.1] Describe the basic concept of series solution of ordinary differential equations which enhance their skills to become employable.

[MA 2215.2] Recognize the different kind of mathematical model with their properties which makes them employable in the field of mathematics teacher as well as in research field.

[MA 2215.3] Understand the concept of transformation of system (specially Laplace transform operator) and their uses for solving differential equations.

[MA 2215.4] Understand the concept of Monte-Carlo simulation modeling.

[MA 2215.5] Enhance the idea of optimization modeling.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. **Critical Thinking**: Critically interpret data, write reports and apply the basics of evidence

[PO.2]. **Effective Communication:** Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO.3]. **Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings

[PO.4]. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities.

[PO.6]. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

[PO.7]. **Self-directed Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

[PSO.1]. to understand the basic Mathematical & Statistical principles and to explain them clearly**.**

[PSO.2]. to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics**.**

[PSO.3]. to develop creative thinking and the power of imagination.

[PSO.4]. to expose the graduates in research in academia and industry for broader applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work at home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Power Series: solution of a differential equation about an ordinary point, solution about a regular singular point, Bessel's equation and Legendre's equation; Laplace Transform and Inverse transform: application to initial value problem up to second order; Monte Carlo Simulation Modeling: simulating deterministic behavior (area under a curve, volume under a surface), Generating Random Numbers: middle square method, linear congruence; Queuing Models: harbor system, morning rush hour, overview of optimization modeling; Linear Programming Model: Geometric solution algebraic solution, simplex method, sensitivity analysis.

F. REFERENCE BOOKS

1. T. Myint-U and L. Debnath, Linear Partial Differential Equation for Scientists and Engineers, Springer, Indian reprint, 2008.
2. M. M. Meerschaert, Mathematical Modeling, Academic Press, 4th edition, 2013.
3. F. R. Giordano, M. D. Weir and W. P. Fox, A First Course in Mathematical Modeling, Thomson Learning, London and New York, 2010.
4. T. Witelski, Methods of Mathematical Modelling: Continuous Systems and Differential Equations, 1st edition, Springer, 2015.

G. Lecture Plan:

Class Number	Topics	Session Outcome	Mode of Delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing Reading and understanding basics of mathematical model	To acquaint and clear teachers' expectations and understand student expectations	Lecture Interaction	-	NA
2	**Power Series:** Introduction to series solution of ODE	To ascertain the interest and recapitulate the understanding about the Power series	Interaction, Discussion & Question Answer Session	CO I, II	In Class Quiz (Not Accounted)
3	solution of a differential equation about an ordinary point	To ascertain the knowledge about the Group theory	Interaction, Discussion & Question Answer Session	CO I, II	Ist Sessional ET Exam Home Assignment
4	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO I, II	
5	solution about a regular singular point	To ascertain the knowledge about the residue classes of the set	Interaction, Discussion & Question Answer Session	CO I, II	
6	**Bessel's equation**: An introduction	To ascertain the knowledge about the Bessel's equation	Interaction, Discussion & Question Answer Session	CO I, II	Ist Sessional ET Exam Home Assignment
7	Properties of Bessel's equation-I	To ascertain the knowledge about more the Bessel's equation	Interaction, Discussion & Question Answer Session	CO1, II	
8	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO I, II	
9	Properties of Bessel's equation-II	To ascertain the knowledge about more the Bessel's equation	Interaction, Discussion & Question Answer Session	CO I, II	Ist Sessional ET Exam Home Assignment
10	**Legendre's equation**: An introduction	To ascertain the knowledge about the Legendre's equation	Interaction, Discussion & Question Answer Session	CO I, II	
11	Properties of Legendre's equation-I	To know more about Legendre's equation	Interaction, Discussion & Question Answer Session	CO I, II	
12	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO I, II	Ist Sessional ET Exam Home Assignment
13	Properties of Legendre's equation-II	To know more about Legendre's equation	Interaction, Discussion & Question Answer Session	CO I, II	
14	**Laplace Transform:** An introduction	To ascertain the knowledge about the Laplace Transform	Interaction, Discussion & Question Answer Session	CO II, III	
15	Properties of Laplace Transform-I	To know the properties of Laplace Transform	Interaction, Discussion & Question Answer Session	CO II, III	Ist Sessional ET Exam
16	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, III	

17	Properties of Laplace Transform-II	To know the properties of Laplace Transform	Interaction, Discussion & Question Answer Session	CO II, III	Home Assignment
18	**Inverse Laplace Transform:** An introduction	To ascertain the knowledge about the inverse Laplace Transform	Interaction, Discussion & Question Answer Session	CO II, III	1st Sessional ET Exam Home Assignment
19	Properties of inverse Laplace Transform-	To know the properties of inverse Laplace Transform	Interaction, Discussion & Question Answer Session	CO II, III	
20	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, III	
21	Applications of Laplace Transform-I	To know the solution of initial value problems	Interaction, Discussion & Question Answer Session	CO II, III	1st Sessional ET Exam Home Assignment
22	Applications of Laplace Transform-II	To know the solution of initial value problems	Interaction, Discussion & Question Answer Session	CO II, III	
23	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, III	
FIRST SESSIONAL EXAM					
24					
25	Monte Carlo Simulation Modeling: An introduction	To know Monte Carlo Simulation Modeling	Interaction, Discussion & Question Answer Session	CO II, IV	2ndSessional ET Exam Home Assignment
26	Simulating deterministic behavior	To know the properties of Monte Carlo Simulation Modeling	Interaction, Discussion & Question Answer Session	CO II, IV	
27	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, IV	2nd Sessional ET Exam Home Assignment
28	Simulating deterministic behavior area under a curve	To ascertain the knowledge about the simulating deterministic behavior under the area of a curve	Interaction, Discussion & Question Answer Session	CO II, IV	
29	Simulating deterministic behavior volume under a surface	To ascertain the knowledge about simulating deterministic behavior volume under a surface	Interaction, Discussion & Question Answer Session	CO II, IV	
30	Generating Random Numbers	To know the properties of Random Numbers	Interaction, Discussion & Question Answer Session	CO II, IV	2ndSessional ET Exam Home Assignment
31	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, IV	
32	Generating Random Numbers: middle square method	To know the properties of middle square method	Interaction, Discussion & Question Answer Session	CO II, IV	
33	linear congruence	To know the properties of linear congruence	Interaction, Discussion & Question Answer Session	CO II, IV	2nd Sessional ET Exam Home Assignment
34	Queuing Models: An introduction	To ascertain the knowledge about Queuing Models	Interaction, Discussion & Question Answer Session	CO II, IV	
35	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, IV	
36	harbor system	To know the properties of harbor system	Interaction, Discussion & Question Answer Session	CO II, IV	2ndSessional

37	morning rush hour	To know the properties of morning rush hour	Interaction, Discussion & Question Answer Session	CO II, IV	ET Exam Home Assignment
38	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, IV	
SECOND SESSIONAL EXAM					
39					ET Exam
40	Optimization modeling; An introduction	To know the about Optimization modeling	Interaction, Discussion & Question Answer Session	CO II, V	
41	Linear Programming Model;	To know the about Linear Programming Model	Interaction, Discussion & Question Answer Session	CO II, V	
42	Properties of Linear Programming Model	To know about properties Linear Programming Model	Interaction, Discussion & Question Answer Session	CO II, V	ET Exam
43	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, V	
44	Geometric solution and algebraic solution	To know about Geometric solution and algebraic solution	Interaction, Discussion & Question Answer Session	CO II, V	
45	Simplex method	To know about Simplex method	Interaction, Discussion & Question Answer Session	CO II, V	
46	sensitivity analysis	To deep understanding on sensitivity analysis.	Interaction, Discussion & Question Answer Session	CO II, V	ET Exam
47	Overview of optimization modeling	To ascertain the knowledge about optimization modeling	Interaction, Discussion & Question Answer Session	CO II, V	ET Exam
48	Tutorial	Discussion & Question Answer Session	Interaction, Discussion & Question Answer Session	CO II, V	ET Exam
END TERM EXAM					

H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes **(POs)**							Correlation with Program Specific Outcomes (**PSOs**)			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3	PSO 4
[MA2215.1]	Describe the basic concept of series solution of ordinary differential equations which enhance their skills to become employable.	**1**		**1**					**2**			**1**
[MA2215.2]	Recognize the different kind of mathematical model with their properties which makes them employable in the field of mathematics teacher as well as in research field.	**2**		**1**		**1**		**1**		**1**		**1**
[MA2215.3]	Understand the concept of transformation of system (specially Laplace transform operator) and their uses for solving differential equations.	**1**	**1**						**1**		**2**	**2**
[MA2215.4]	Understand the concept of Monte-Carlo simulation modeling.	**2**		**1**	**1**						**3**	
[MA2215.5]	Enhance the idea of optimization modeling.		**2**				**1**		**1**			**2**

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics

Course Hand – Out

STATISTICAL INFERENCE | MA2240| 3 Credits | 2 1 0 3

Session: Jan. 21 – May 21| Faculty: **Dr. Ashish Kumar**| Class: B.Sc. IV Sem.

A. Introduction:-

Statistical inference is the branch in which we draw inference about the population parameters on the basis of sample information. It is an important subject and plays a key role in all spheres of data analysis. The course aims at providing the basics of estimation theory which emphasis on some commonly encountered estimation procedures.

B. Course Outcomes: At the end of the course, students will be able to

2240.1	Understand conceptual framework of estimation and estimators
2240.2	Understand conceptual framework of estimation procedures and their implementation
2240.3	Understand conceptual framework of point estimation and interval estimation to enhance employability skills.
2240.4	Understand conceptual framework of tests of significance.
2240.5	Understand the framework of parametric and non-parametric test for increasing data analysis skills for employability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.

[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	20
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Estimation: Parametric space, sample space; Point Estimation: Properties of good estimator: Consistency, unbiasedness, efficiency, sufficiency. Neymann factorization theorem, complete sufficient statistics, minimum – variance unbiased (MVU) estimators, exponential family of distributions and its properties, Cramer- Rao inequality, minimum variance bound (MVB) estimators; Interval Estimation: Confidence intervals for the parameters of various distributions, confidence intervals for difference of means and for ratio of variances; Methods of Estimation: Method of maximum likelihood, methods of moments; Elements of Statistical Decision Theory: Neyman theory of testing of hypotheses, simple and composite hypotheses, null and alternative hypotheses, two types of errors, critical region, level of significance, power of the test, unbiased tests, Neyman- Pearson lemma, construction of most powerful test, uniformly most powerful test, uniformly most powerful unbiased test; Tests of Significance: tests of significance based on t, F and Chi-square distributions.

F. TEXT BOOKS:-

1. A.M. Goon, M.K. Gupta and B. Dasgupta, An Outline of Statistical Theory, Vol. II, 3rd edition, World Press, Kolkata, 2005.
2. M Kendall, A. Stuart and J.K. Ord, Kendall's Advanced Theory of Statistics, Oxford University Press, 5th edition, 1991.
3. P. Mukhopadhyay, Applied Statistics, Books & Allied Ltd., 2011.
5. R.V. Hogg, and E.A. Tanis, Probability and Statistical Inference, 9th edition, Macmillan Publishing Co. Inc., 2014.

G. REFERENCE BOOKS:-

1. Casella, G. and Berger, R.L., Statistical Inference, Second Edn. Thomson Duxbury, 2002.
2. Hogg, R.V. and Tanis, E.A., Probability and statistical inference, 3rd Edn. Macmillan Publishing Co. Inc., 1988.
3. Rohatgi, V. K., Statistical Inference, John Wiley and Sons, 1984.
4. Mukhopadhyay, P., Applied Statistics, Books & Allied (P) Ltd., 2011.

H. Lecture Plan:-

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Estimation:** Parametric space, sample space.	Understand conceptual framework of estimation and estimators	Lecture	**2240.1**	Class Quiz Mid Term I End Term
2,3	**Point Estimation:** Properties of good estimator: Consistency, unbiasedness, efficiency, sufficiency.	Understand conceptual framework of estimation and estimators	Lecture	**2240.1**	Class Quiz Mid Term II End Term
4	Neymann factorization theorem	Understand conceptual framework of estimation and estimators	Lecture	**2240.1**	Class Quiz Mid Term II End Term
5,6,7	Complete sufficient statistics, Minimum – variance unbiased (MVU) estimators, exponential family of distributions and its properties,	Understand conceptual framework of estimation procedures and their implementation	Lecture	**2240.2**	Class Quiz Mid Term II End Term
8,9	Cramer- Rao inequality, Minimum variance bound (MVB) estimators,	Understand conceptual framework of estimation	Lecture	**2240.2**	Class Quiz Mid Term II End Term

		procedures and their implementation			
10.11.12	**Methods of Estimation**: Method of Maximum Likelihood, Minimum chi-square and modified minimum chi- square and their properties.	Understand conceptual framework of point estimation and interval estimation to enhance employability skills.	Lecture	**2240.3**	Class Quiz Mid Term II End Term
13,14,15	Interval Estimation: Confidence intervals for the parameters of various distributions, confidence intervals for difference of means and for ratio of variances;	Understand conceptual framework of point estimation and interval estimation to enhance employability skills.	Lecture	**2240.3**	Class Quiz Mid Term II End Term
16	**Elements of Statistical Decision Theory:** Neymann theory of testing of hypotheses	Understand the concept of statistical decision theory	Lecture	2240.4	Home Assignment Class Quiz Mid Term I End Term
17	simple and composite hypotheses, null and alternative hypotheses, two types of errors, critical region, level of significance		Lecture	2240.4	Class Quiz Mid Term II End Term
18,19	power of the test, unbiased tests, N-P lemma, construction of most powerful test, uniformly most powerful test, uniformly most powerful unbiased test.	Understand the concept of statistical decision theory	Lecture	2240.4	Home Assignment Class Quiz Mid Term I End Term
20,21	**Sampling Distributions:** Chi-	Understand conceptual framework of sampling	Lecture	2240.4	Class Quiz Mid Term I End term

	square distribution and their applications.	distributions and their implementation			
22	Student's t distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	2240.4	Class Quiz Mid Term I End Term
23	Seducer's F distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	2240.4	Class Quiz Mid Term I End Term
24	Fisher's-Z distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	2240.4	Class Quiz Mid Term I End Term
25,26	**Tests of Significance:** tests of significance based on t	Understand conceptual framework of tests of significance.	Lecture	2240.5	Class Quiz End Term Mid Term I
27,28	tests of significance based on Z	Understand conceptual framework of tests of significance.	Lecture	2240.5	Class Quiz End Term Mid Term I
29	tests of significance based on F	Understand conceptual framework of tests of significance.	Lecture	2240.5	Class Quiz Mid Term II End Term
30	tests of significance based on Chi Square	Understand conceptual framework of tests of significance.	Lecture	2240.5	Class Quiz Mid Term II End Term
31	**Non-Parametric Tests:** Empirical distribution function, one sample and two-sample sign test.	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	2240.5	Class Quiz Mid Term II End Term

32	Wald-Wolfowitz run test, run test for randomness,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	2240.5	Class Quiz Mid Term II End Term
33	Median test,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	2240.5	Class Quiz Mid Term II End Term
34	Wilcoxon-Mann-Whitney U-test,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	2240.5	Class Quiz Mid Term II End Term
35	Kolmogorov-Smirnov one-sample test,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	2240.5	Class Quiz Mid Term II End Term
36	Kruskal-Wallis test	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	2240.5	Class Quiz Mid Term II End Term

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA2240.1	Understand conceptual framework of estimation and estimators	**2**			**2**			**3**				
MA22402	Understand conceptual framework of estimation procedures and their implementation		**2**	**3**		**2**						
MA2240.3	Understand conceptual framework of point	2		**3**			**1**					

	estimation and interval estimation to enhance employability skills.											
MA2240.4	Understand conceptual framework of tests of significance.		**3**		**2**			**3**				
MA2240.5	Understand the framework of parametric and non-parametric test for increasing data analysis skills for employability.	**2**		**2**			**2**					

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

J. Course Outcome Attainment Level Matrix:-

CO	**STATEMENT**	**ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%**							**ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES**			
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PS O 1**	**PS O 2**	**PS O 3**	**PS O 4**
MA2240.1	Understand conceptual framework of estimation and estimators											
MA2240.2	Understand conceptual framework of estimation procedures and their implementation											
MA2240.3	Understand conceptual framework of point estimation and interval estimation to enhance employability skills.											
MA2240.4	Understand conceptual framework of tests of significance.											
MA2240.5	Understand the framework of parametric non-parametric test for increasing data analysis skills for employability.											

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY
JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

Lab on Statistical Inference| MA2230 | 1 Credits | 0 0 2 1

Session: Jan. 2021– May 2021 | Faculty: Dr. Monika Saini| Class: B.Sc. IV Sem.

A. Introduction:-

Statistical inference is the branch in which we draw inference about the population parameters on the basis of sample information. It is an important subject and plays a key role in all spheres of data analysis. The course aims at providing the basics of estimation theory which emphasis on some commonly encountered estimation procedures.

B. Course Outcomes: At the end of the course, students will be able to

2230.1	Understand conceptual framework of point estimation and interval estimation to enhance employability skills.
2230.2	Understand conceptual framework of tests of significance.
2230.3	Understand the framework of parametric and non-parametric test for increasing data analysis skills for employability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO.1	to teach a wide range of Mathematics & Statistics at a basic level and stimulate the interest of students in Mathematics & Statistics
PO.2	producing graduates who are well grounded in the fundamentals of Mathematics & Statistics and acquisition of the necessary skills, in order to use their knowledge in Mathematics & Statistics in a wide range of practical application.
PO.3	To acquire discipline – based skills in pure Mathematics, applied Mathematics, Mathematical Statistics and Operations research.
PO.4	To analyse situations, search for truth and extract information, formulate and solve problems in a systematic and logical manner.
PO.5	Graduates of the program will continue to learn and to adapt in a world of constantly evolving and innovative technology
PO.6	Function on multidisciplinary teams by working cooperatively, creatively and responsibly as a member of a team
PO.7	Pursue for Master's program in Mathematics, Statistics and Operations Research.
PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.
PSO.2	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
PSO.3	to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Lab	Practical Lab Exam	40
	Day to Day Assessment	60
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity will be assessed and marks will be awarded.	

E. SYLLABUS:-

The following practical will be performed using statistical software: Method of maximum likelihood, methods of moments, minimum chi- square and modified minimum chi- square, computation of confidence intervals for the parameters of various distributions, confidence intervals for difference of means and for ratio of variances, confidence interval for binomial proportion and population correlation coefficient when population is normal.

F. TEXT BOOKS:-

1. A.K. Sharma. *Text Book of Biostatistics I*. Discovery Publishing House, New Delhi, 2005.
2. B.K. Mahajan. *Methods in Biostatistics*. Jaypee Brothers Publishers, New Delhi. 2002.
3. B. L. Agarwal. *Basic Statistics.* New Age International, New Delhi, 2006.

G. **REFERENCE BOOKS:-**

1. B. Rosner. *Fundamentals of Biostatistics*. Brooks/Cole Cengage learning, USA. 2010.
2. M. Pagano and K. Gauvreau. *Principles of Biostatistics*. Brooks/Cole Cengage Learning, USA. 2007.
3. S. Boslaugh. *Statistics in a Nutshell*. O'Reilly Publishers, New York. 2012.

H. **Lecture Plan:-**

S No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode Of Assessing CO
l	Method of Maximum Likelihood,	Understand conceptual framework of point estimation	Demonstration	2230.l	Quiz I, Viva voce & End Term
2	Minimum chi-square and modified minimum chi-square and their properties.	Understand conceptual framework of point			
2	Interval Estimation: Confidence intervals for the parameters of various distributions,	Understand conceptual framework of interval estimation	Demonstration	2230.l	Quiz I, Viva voce & End Term
3	confidence intervals for difference of means and for ratio of variances;	Understand conceptual framework of interval estimation	Demonstration	2230.l	Quiz I, Viva voce & End Term
4	Program on single sample t-test	Recall conceptual framework of parametric statistic	Demonstration	2230.2	Quiz II Viva voce & End Term
5	Program on independent sample t-test	Recall conceptual framework of parametric statistic	Demonstration	2230.2	Quiz II Viva voce & End Term
6	Program on paired sample t-test	Recall conceptual framework of parametric statistic	Demonstration	2230.3	Quiz II, Viva voce & End Term

7	Program on Chi square test	Recall conceptual framework of parametric statistic	Demonstration	2230.3	Quiz II, Viva voce & End Term
8	Program on Non Parametric test: Sign test	Recall conceptual framework of non-parametric statistic	Demonstration	2230.3	Quiz II, Viva voce & End Term
9	Program on Non Parametric test: Run test	Recall conceptual framework of non-parametric statistic	Demonstration	2230.3	Quiz II, Viva voce & End Term
10	Program on Non Parametric test: median test	Recall conceptual framework of non-parametric statistic	Demonstration	2230.3	Quiz II, Viva voce & End Term
11	End Term Exam				

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME									
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
2230.1	Understand conceptual framework of point estimation and interval estimation to enhance employability skills.	**2**			**2**			**3**			
2230.2	Understand conceptual framework of tests of significance.		**2**	**3**		**2**					
2230.3	Understand the framework of parametric and non-parametric test for increasing data analysis skills for employability.	2		**3**			**1**				

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of School of Basic Science

Department of Mathematics and Statistics
Course Hand-out

Discrete Mathematical Structure | MA1501 | 4 Credits | 3 1 0 4

Session: July 2020 – December 2020 | Faculty: Dr. Kalpna Sharma | Class: B. Sc. (Hons) Mathematics

Introduction: Introduction: This course is offered by Dept. of Mathematics & Statistics as a regular course, targeting students who wish to pursue B.Sc. (Hons), in Mathematics. It offers in depth knowledge of sets, relations, functions, Basic counting techniques, propositional and predicate and propositional logic, basic/introductory level algebraic structures and basic/introductory of recurrence relations and generating functions. Students are expected to have background knowledge on number system.

A. Course Outcomes: At the end of the course, students will be able to:

[1501.1]. Apply the operations of sets, Determine the domain and range of a discrete or non-discrete function

[1501.2]. Find the partition for a set through equivalence classes, finding generating function for a given sequence of real numbers

[1501.3]. Describe the concept of predicates, quantifiers, logical connectives and their properties which enhance the logical and programming skills and make them employable in the relevant industry.

[1501.4]. Solve counting problems by applying elementary counting techniques using the product and sum rule, model a recurrent relation and finding solution to the problem by solving recurrence relation

[1501.5]. Produce examples and counter examples illustrating the mathematical concepts and its application to develop mathematical and analytic skills

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO's:

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

B. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

C. SYLLABUS

Propositional calculus: Propositions; Logical connectives; Tautologies and contradictions; Contrapositive; Logical equivalences and implications; De Morgan's Laws; Normal forms; Rules of inference; Arguments. **Predicate calculus:** Predicates; Statement function; Variables; Quantifiers; Logical equivalences and implications for quantified statements; Validity of arguments. **Set theory:** Basic concepts; Algebra of sets; Types of relations and their properties; Relational matrix and the graph of a relation; Partitions; Equivalence relations; Poset; Hasse diagram. **Functions:** Classification; Type of functions; Binary and n-ary operations; Characteristic function of a set; Hashing functions; Recursive functions; Permutation functions; Discrete numeric function and generating functions; Recurrence relations and recursive algorithms; Linear recurrence relations with constant coefficients; Homogeneous solution; Particular solution; Total solution; Solution by the method of generating function.

Textbooks:

1. J. P. Trembly and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2003.
2. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill international edition, 2010.
3. T. Veerarajan, Discrete Mathematics, Tata McGraw Hill, 3rd Edition, 2010.

Reference Books:

1. B. Kolman, R. C. Busby and S. C. Ross, Discrete Mathematical Structures, Pearson Education Pvt. Ltd., New Delhi, 2003.
2. K. H. Rosen, Discrete Mathematics and Its Applications, Tata Mc-Graw Hill Pub. Co. Ltd., 5th Edition, New Delhi, 2003.
3. R. Johnsonbaugh, Discrete Mathematics, Pearson Education Asia, Fifth Edition, New Delhi, 2002.

D. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	**Introduction:**	To acquaint and clear teachers' expectations and understand student expectations	Lecture	1501.1	Home Assignment Class Quiz
2.	**Set theory:** Basic concepts	Basic Concept of set theory	Lecture	1501.1	Home Assignment Class Quiz Mid Term I End Term
3.	Algebra of sets	Recall working of sets	Lecture	1501.1	Home Assignment Class Quiz Mid Term I End Term
4.	Tutorial	Understanding of Set theory	Tutorial class	1501.5	Class Quiz
5.	Types of relations and their properties	Identify different relations on the sets and their formation	Lecture	1501.1	Home Assignment Class Quiz Mid Term I End Term
6.	Relational matrix and the graph of a relation	Explain matrix on relations	Lecture	1501.1	Home Assignment Class Quiz Mid Term I End Term
7.	Equivalence relations and Partitions	Explain the equivalence relations and partitions of the sets with their applications	Lecture	1501.2	Home Assignment Class Quiz Mid Term I End Term
8.	Tutorial	Problems based on relations	Tutorial	1501.5	Class Quiz
9.	Poset, Hasse diagram	Explain POSET and define Hasse diagram on set theory with relations	Lecture	1501.2	Home Assignment Class Quiz Mid Term I End Term
10.	Functions: Classification; Characteristic function of a set	Recall set and identify the classification of functions	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
11.	Type of functions	Recall set and define the types of functions with examples	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
12.	Tutorial	Problems based on POSET, Hasse diagram and functions	Tutorial	1501.5	Class Quiz
13.	Binary and n-ary operations	Define Binary and n-ary operations	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
14.	Hashing functions,	Describe Hashing functions	Lecture	1501.4	Class Quiz Mid Term II End Term
15.	Recursive functions	Describe the working process of Recursive functions	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
16.	Tutorial	Recall set, functions and problems based	Tutorial	1501.5	Class Quiz

		on Hashing function & Recursive functions			
17.	Permutation functions	Defined permutation function and relate to combination	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
18.	Discrete numeric function	Describe the working of Discrete numeric function	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
19.	Generating functions	Describe the working of generating functions	Lecture	1501.4	Home Assignment Class Quiz Mid Term I End Term
20.	Tutorial	Problems based on Discrete numeric function and generating functions	Tutorial	1501.5	Class Quiz
21.	Recurrence relations,	Describe the working of Recurrence relations,	Lecture	1501.4	Home Assignment Class Quiz Mid Term II End Term
22.	Recursive algorithms	Describe recursive algorithms	Lecture	1501.4	Home Assignment Class Quiz Mid Term II End Term
23.	Linear recurrence relations with constant coefficients	Explain Linear recurrence relations with constant coefficients	Lecture	1501.4	Home Assignment Class Quiz Mid Term II End Term
24.	Tutorial	Problems based on Recurrence Relation	Tutorial	1501.5	Class Quiz
25.	Homogeneous solution;	Describe the working of Homogeneous solution;	Lecture	1501.4	Home Assignment Class Quiz Mid Term II End Term
26.	Total solution & Particular solution	Describe the working of Total solution and Find Particular solution	Lecture	1501.4	Home Assignment Class Quiz Mid Term II End Term
27.	Solution by the method of generating function	Describe the working of Solution by the method of generating function	Lecture	1501.4	Home Assignment Class Quiz Mid Term II End Term
28.	Tutorial	Problems based on Recurrence Relation	Tutorial	1501.5	Class Quiz
29.	Propositional calculus:	To understand the Basics of propositions	Flipped Classroom	1501.3	Home Assignment Class Quiz Mid Term II End Term
30.	Logical connectives, Tautologies and contradictions	Describe Logical connectives, Tautologies and contradictions	Flipped Classroom	1501.3	Home Assignment Class Quiz Mid Term II End Term
31.	Propositions	Describe Propositions	Flipped Classroom	1501.3	Home Assignment Class Quiz Mid Term II End Term
32.	Tutorial	Problems based on Propositional calculus:	Tutorial	1501.5	Class Quiz

33.	Logical equivalences and implications	To acquaint and clear teachers expectations and understand student expectations	Lecture	1501.3	Class Quiz Mid Term II End Term
34.	De Morgan's Laws	Describe the working of De Morgan's Laws	Lecture	1501.3	Home Assignment Class Quiz Mid Term II End Term
35.	Normal forms	Describe the working of Normal forms	Lecture	1501.3	Home Assignment Class Quiz Mid Term II End Term
36.	Tutorial	Problems based on Logical equivalences and implications	Tutorial	1501.5	Class Quiz
37.	Rules of inference	Describe the working of Rules of inference	Lecture	1501.3	In Class Quiz End Term
38.	Arguments	Describe the working of Arguments	Lecture	1501.3	In Class Quiz End Term I End Term
39.	Predicate calculus: Validity of arguments.	Compare formation of CO between Predicate calculus: Validity of arguments	Lecture	1501.3	Home Assignment In Class Quiz End Term
40.	Tutorial	Problems based on Predicate calculus, Validity of arguments	Tutorial class	1501.5	Class Quiz
41.	Contrapositive	Describe the working of Contrapositive	Lecture	1501.3	Home Assignment In Class Quiz End Term
42.	Predicates	Describe the working of Predicates	Lecture	1501.3	Home Assignment In Class Quiz End Term
43.	Statement function	Describe the working of Statement function	Lecture	1501.3	Home Assignment In Class Quiz End Term
44.	Tutorial	Describe the working of Arguments	Tutorial class	1501.5	Class Quiz
45.	Variables	Describe the working of Variables	Lecture	1501.3	Home Assignment In Class Quiz End Term
46.	Quantifiers	Describe the working of Quantifiers	Lecture	1501.3	Home Assignment In Class Quiz End Term
47.	Logical equivalences and implications for quantified statements	Describe the working of Quantifiers	Lecture	1501.3	Home Assignment In Class Quiz End Term
48.	Tutorial	Problems based on Logical equivalences and implications for quantified statements	Tutorial class	1501.5	Class Quiz

E. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES **THRESHOLD VALUE: 40%**							ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 1501.1	Apply the operations of sets, Determine the domain and range of a discrete or non-discrete function.	1	2	1	0	0	0	1	2	2	1	
MA 1501.1	find the partition for a set through equivalence classes, finding generating function for a given sequence of real numbers	2	1	1	0	0	0	1	1	1	1	
MA 1501.2	Describe the concept of predicates, quantifiers, logical connectives and their properties which enhance the logical and programming skills and make them employable in the relevant industry.	1	3	0	0	0	1	1	1	1	1	
MA 1501.4	Solve counting problems by applying elementary counting techniques using the product and sum rule, model a recurrent relation and finding solution to the problem by solving recurrence relation	2	2	1	0	0	0	2	1	1	1	
MA 1501.5	Produce examples and counter examples illustrating the mathematical concepts and its application to develop mathematical and analytic skills	1	2	1	0	0	0	1	1	1	2	

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences
Department of Mathematics and Statistics
Course Hand-out
Mathematical Statistics | MA1502 | 4 Credits | 3 1 0 4

Session: Jul 20 – Dec 20 | Faculty: Dr. Laxmi Poonia | Class: Compulsory

A. Introduction: This course is offered by dept. of Mathematics and Statistics for Mathematics (Hons.) students, targeting students who wish to pursue research& development in industries or higher studies in field of Mathematics and Engineering. Offers in depth knowledge of Probability theory, conditional probability, Bays theorem and probability function and gives an introductory level knowledge on expectation, MGF, variance and covariance, distribution functions, correlation and Regression analysis. Students are expected to have background knowledge on solving set theory based questions, number theory and Basic mathematics for a better learning.

B. Course Outcomes: At the end of the course, students will be able to

[1502. 1]	Solve problems based on probability theory and employ to use the concepts in the relevant field.
[1502.2]	Learn to apply the different probability functions, concepts of variance, covariance, expectation, MGF, etc. in various mathematical problems.
[1502.3]	Employ the concept of different distribution functions to solve problems related with statistics that will enhance logical thinking skills.
[1502.4]	Solve the mathematical problems related to curve fitting, to make understanding of student for self-directed lifelong learning.
[1502.5]	Learn to apply the concepts of correlation and regression, in various mathematical problems and use their properties and different standard results in their relevant field, to make students effective citizen.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

The PO's of B.Sc. in Mathematics program are:

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

The PSO's of B.Sc. in Mathematics program are :

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Open Book)	20
	Sessional Exam II (Open Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Open Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Probability theory: Dependent, independent and compound events; Definitions of probability; Addition and multiplication theorems of probability; Conditional probability; Bayes theorem and its applications; **Random variable:** Definition with illustrations; Probability mass function; Probability density function; Distribution function and its properties; Expectation and its properties; Definition of variance and covariance and properties; Raw and central moments; Moment generating functions (m.g.f.) and Cumulates generating functions (c.g.f.). **Discrete distributions:** Binomial, Poisson and Geometric distributions and their properties. **Continuous distributions:** Rectangular, Normal distributions and Exponential and their properties. **Curve fitting:** Method of least squares; Fitting of straight line, Parabola and exponential curves. **Correlation and regression:** Bivariate population; Meaning of correlation & regression; Coefficient of correlation; Rank correlation; Lines of regression; Properties of regression coefficients.

Text Books:

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2014.
2. A. M. Mood, F. A. Graybill and D. C. Bose, Introduction to the Theory of Statistics, McGraw Hill, 2001.

Reference Books:

1. P. G. Hoel, Introduction to Mathematical Statistics, John Wiley & sons, 2000.

2. G. W. Snedecor and W.G. Cochran, Statistical Methods, Iowa State University Press, 1989.

3. M. R. Spiegel, Theory and Problem of Statistics, Schaum's Publishing Series, 2008.

4. A. M. Goon, A. K. Gupta and B. D. Gupta, Fundamental of Statistics, Vol. I, World Press, Calcutta, 1999.

F. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Introduction and Course Hand-out briefing	Have awareness about course	Lecture	MA1502.1	Class quiz, MTE 1, ETE
2	Probabbility – Introduction- simple event, experiment, sample space	Understanding the concepts of probability	Lecture	MA1502.1	Class quiz, MTE 1, ETE
3	Methods of determining Probability theory	Discuss the three basic methods of finding probability	Lecture	MA1502.1	Class quiz, MTE 1, ETE
4	Classical method	Questions based on method	Lecture	MA1502.1	Class quiz, MTE 1, ETE
5	Empirical method, subjective method	Questions based on method	Lecture	MA1502.1	Class quiz, MTE 1, ETE
6	simulations on probability	Learn the simulations of probability theory	Lecture	MA1502.1	Class quiz, MTE 1, ETE
7,8,9	properties of probability, addition rule	Understanding the properties	Lecture	MA1502.1	Class quiz, MTE 1, ETE
10,11	Explanation of probability theory by Venn diagram and problems based on Venn diagram	Discuss the Venn diagram in reference to probability theory	Lecture	MA1502.1	Class quiz, MTE 1, ETE
12,13	Conditional probability,	problems based on topics	Lecture	MA1502.1	Class quiz, MTE 1, ETE
14,15	Multiplication Rule	problems based on topics	Lecture	MA1502.1	Class quiz, MTE 1, ETE
16,17	Baye's theorem	Understating the theorem and problem taking	Lecture	MA1502.1	Class quiz, MTE 1, ETE
18,19,20	Random variable**,** Definition with illustrations	Discuss the problems on the random variables	Lecture	MA1502.2	Class quiz, MTE 1, ETE
21,22	Probability mass function	Learn the problems related to the topic	Lecture	MA1502.2	Class quiz, MTE 1, ETE
23,24	Probability density function	Learn the problems related to the topic	Lecture	MA1502.2	Class quiz, MTE 1, ETE
25,26	Distribution function and its properties	Questions based on distribution function	Lecture	MA1502.3	Class quiz, MTE 1, ETE
27,28	Expectation and its properties	Learn to solve problems based on this	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
29,30,31	Definition of variance and covariance and properties	Understanding the topics	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE

32	Raw and central moments	Learn these topics	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
33,34	Moment generating functions (m.g.f.) and Cumulates generating functions (c.g.f.).	Learn these topics	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
35, 36	Discrete distributions, Binomial distribution and its properties.	Discuss the Binomial distributions and question based on this topic	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
37,38	Poisson and Geometric distributions and	Discuss these distributions and question based on this topic	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
39,40	Continuous distributions Rectangular,	Learn to practice problems related to properties of these distributions	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
41	Normal distributions and its properties	Learn to practice problems related to properties of these distributions	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
42	Exponential distributions and its properties	Learn to practice problems related to properties of these distributions	Lecture	MA1502.3	MTE 2, Class quiz, Assignment, ETE
43	Curve fitting, Method of least squares; Fitting of straight line	Understating the concept curve fitting	Lecture	MA1502.4	MTE 2, Class quiz, Assignment, ETE
44	Fitting of Parabola	Understating the concept curve fitting	Lecture	MA1502.4	Quiz, Assignment, ETE
45	Fitting of exponential curves	Understating the concept of exponential curves	Lecture	MA1502.4	Quiz, Assignment, ETE
46,47,48	Correlation	Understand the Coefficient of correlation and rank correlation	Lecture	MA1502.5	Quiz, Assignment, ETE
49,50,51	Regression	Discuss lines of regression; Properties of regression coefficients.	Lecture	MA1502.5	Quiz, Assignment, ETE

l. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT							CORRELATION WITH SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
[1502. 1]	Solve problems based on probability theory and employ to use the concepts in the relevant field.	3		2	2	1		2	3	3	2	2
[1502.2]	Learn to apply the Different probability functions, concepts of variance, covariance, expectation, MGF, etc. in various mathematical problems.	2	1	1	2	1		1	3	3	2	2
[1502.3]	Employ the concept of different distribution functions to solve problems related with statistics that will enhance logical thinking skills.	1	1	2	2	1	2	2	3	3	2	2
[1502.4]	Solve the mathematical problems related to curve fitting, to make understanding of student for self-directed lifelong learning.	2		2	3		2	2	3	3	2	2
[1502.5]	Learn to apply the concepts of Correlation and regression, in various mathematical problems and use their properties and different standard results in their relevant field, to make students effective citizen.	1	1		2		2	2	3	3	2	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY
JAIPUR

School of Basic Sciences

Department of Mathematics and Statistics

Course Hand-out

DYNAMICS | MA1503 | 4 Credits | 3 1 0 4

Session: July, 20– Dec, 20 | Faculty: Dr. Rishikesh Dutta Tiwary| Class: B. Sc. Mathematics (Hons) V Sem

A. Introduction: This course introduces the concepts like position, velocity and acceleration, which describe the way an object moves. Also discusses the Newton's laws of motion, which predict the motion of an object when the forces acting on it are known. It also shows how Newton's second law of motion can be used to predict the motion of objects. The course concerns modelling some of the forces that occur in nature, which enables more realistic situations to be analyzed.

B. Course Outcomes: At the end of the course, students will be able to think logically.

[1503.1] Students will be able to understand the basic terms for the description of the motion of particles in a straight line and in a plane and it will hone their skills.

[1503.2] Learners will solve the problems relating to the Simple harmonic motion & motion of a projectile in the absence of air resistance.

[1503.3] Students will be able to understand the basic concepts of force, mass and acceleration, of work and energy and of impulse and momentum.

[1503.4] Students will demonstrate the ability to resolve the problems in one dimension that involve one or more of the forces of gravity, friction and air resistance.

[1503.5] Students will be able to understand the orbital motion of planets in a lucid way and it will improve their employability.

C. Program Outcomes and Program Specific Outcomes

[PO.1].Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2].Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1]. To understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2]. To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

[PSO.3]. To develop creative thinking and the power of imagination.

[PSO.4]. To expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (Summative)	Sessional Exam I **(Closed Book)**	20
	Sessional Exam II **(Closed Book)**	20
	Quizzes , Assignments & Presentation	10
End Term Exam (Summative)	End Term Exam **(Closed Book)**	50
	Total	100

E. Syllabus

Kinematics and kinetics: Fundamental notions and principles of dynamics; Laws of motion; Relative velocity. **Kinematics:** Radial, transverse, tangential, normal velocities and accelerations; Simple harmonic motion; Repulsion from a fixed pint; Motion under inverse square law; Hooke's law; Horizontal and vertical elastic strings; Motion on an inclined plane; Motion of a projectile; Work, energy and impulse;

Conservation of linear momentum; Principle of conservation of energy; Uniform circular motion; Motion on a smooth curve in a vertical plane; Motion on the inside of a smooth vertical circle; Cycloidal motion; Motion in the resisting medium; Resistance varies as velocity and square of velocity. **Central forces:** Stability of nearly circular orbits; Kepler's laws; Time of describing an arc and area of any orbit; Slightly disturbed orbits.

F. Text Books:

1. P. S. Deshwal, Particle Dynamics, New Age International, New Delhi, 2000.
2. M. Ray and G. C. Sharma, A Text Book on Dynamics, S. Chand and Co., 2010.

G. Reference Books:

1. A. S. Ramsey, Dynamics, Cambridge University Press, 2009.
2. S. L. Loney, An Elementary Treatise on the Dynamics of a Particle, Cambridge University Press, 2013.

H. Lecture Plan:

Lecture Number	Topic	Session Outcome	Mode of delivery	Corresponding Course Outcome	Mode of Assessing the Outcome
1	**Kinematics**: Introduction	Students will get acquaintance with the basic concept of Kinematics	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
2	Radial velocity	To develop the understanding of 2D motion in various coordinate system	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
3	Radial acceleration	To develop the understanding of 2D motion in various coordinate system	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
4	Transverse velocity	To develop the understanding of 2D motion in various coordinate system	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
5	Transverse acceleration	To develop the understanding of 2D motion in various coordinate system	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
6	Tangential & Normal velocities	To develop the understanding of 2D motion in various coordinate system	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
7	Tangential & Normal accelerations	To develop the understanding of 2D motion in various coordinate system	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
8	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
9	**SHM (Simple Harmonic Motion)** :Introduction	To cultivate the better understanding of SHM	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
10	Simple Harmonic Motion	To cultivate the better understanding of SHM	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
11	Motion under inverse square Law	To develop the notion of inverse square Law	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination

12	Hooke's law	To understand the motion in an elastic string	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
13	Horizontal and vertical elastic strings	To understand the motion in an elastic string	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
14	Horizontal and vertical elastic strings	To understand the motion in an elastic string	Lecture, Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
15	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.1	Quizzes, Two Sessional, End Term Examination
16	**Projectile**: Introduction	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
17	Motion of a particle and its trajectory	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
18	Motion of a particle and its trajectory	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
19	Time of flight & Horizontal range	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
20	Time of flight & Horizontal range	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
21	Greatest height and time of flight up & down an inclined plane	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
22	Greatest height and time of flight up & down an inclined plane	Identify and explain the properties of a projectile	Lecture, Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
23	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.2	Quizzes, Two Sessional, End Term Examination
First Sessional Exam					
24	**Work, Energy and Impulse:** Introduction	Students will understand and be able to apply the work-energy theorem	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
25	Conservation of linear momentum	Students will understand and be able to apply the work-energy theorem	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
26	Conservation of linear momentum	Students will understand and be able to apply the work-energy theorem	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
27	Principle of conservation of energy	Students will understand and be able to apply the work-energy theorem	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
28	Principle of conservation of energy	Students will understand and be able to apply the work-energy theorem	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
29	Cycloidal motion	Explain the concept of Cycloidal motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
30	Cycloidal motion	Explain the concept of Cycloidal motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination

31	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
32	**Uniform circular motion:** Introduction	To understand the basic ideas of vertical circular motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
33	Motion on a smooth curve in a vertical plane	To understand the basic ideas of vertical circular motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
34	Motion on a smooth curve in a vertical plane	To understand the basic ideas of vertical circular motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
35	Motion on the inside of a smooth vertical circle	To understand the basic ideas of vertical circular motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
36	Motion on the inside of a smooth vertical circle	To understand the basic ideas of vertical circular motion	Lecture, Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
37	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.3	Quizzes, Two Sessional, End Term Examination
38	**Motion in the resisting medium:** Introduction	Students will be able to analyze the effect of resistive medium	Lecture, Discussion & Examples	1503.4	Quizzes, Two Sessional, End Term Examination
39	Resistance varies as velocity	Students will be able to analyze the effect of resistive medium	Lecture, Discussion & Examples	1503.4	Quizzes, Two Sessional, End Term Examination
40	Resistance varies as velocity	Students will be able to analyze the effect of resistive medium	Lecture, Discussion & Examples	1503.4	Quizzes, Two Sessional, End Term Examination
41	Resistance varies as square of velocity	Students will be able to analyze the effect of resistive medium	Lecture, Discussion & Examples	1503.4	Quizzes, Two Sessional, End Term Examination
42	Resistance varies as square of velocity	Students will be able to analyze the effect of resistive medium	Lecture, Discussion & Examples	1503.4	Quizzes, Two Sessional, End Term Examination
Second Sessional Exam					
43	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.4	Quizzes, Two Sessional, End Term Examination
44	Central orbits	Students will be able to understand the planetary motion	Lecture, Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination
45	Central orbits	Students will be able to understand the planetary motion	Lecture, Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination
46	Kepler's laws of planetary motion	Students will be able to understand the planetary motion	Lecture, Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination
47	Kepler's laws of planetary motion	Students will be able to understand the planetary motion	Lecture, Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination
48	Time of describing an	Students will be able to understand the planetary motion	Lecture, Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination

	arc and area of any orbit				
49	Slightly disturbed orbits	Students will be able to understand the planetary motion	Lecture, Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination
50	**Tutorial Class**	Students will be able to apply the concepts	Discussion & Examples	1503.5	Quizzes, Two Sessional, End Term Examination
End Term Exam					

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	**STATEMENT**	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 1503.1	Students will be able to understand the basic terms for the description of the motion of particles in a straight line and in a plane and it will hone their skills	3	2	1	2	1		3	3	3	2	1
MA 1503.2	Learners will solve the problems relating to the Simple harmonic motion & motion of a projectile in the absence of air resistance	3	2	1	2	1		3	3	3	2	1
MA 1503.3	Students will be able to understand the basic concepts of force, mass and acceleration, of work and energy and of impulse and momentum	3	2	1	2	1		3	3	3	2	1
MA 1503.4	Students will demonstrate the ability to resolve the problems in one dimension that involve one or more of the forces of gravity, friction and air resistance	3	2	1	2	1	2	3	3	3	2	1
MA 1503.5	Students will be able to understand the orbital motion of planets in a lucid way and it will improve their employability.	3	2	1	2	1		3	3	2	2	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics

Course Hand-out

Numerical Methods | MA1504 | 4 Credits | 3 1 0 4

Session: July – December 20 | Faculty: Dr. Alok Bhargava | Class: B.Sc. (Hons.) V Sem.

A. Introduction: The Graduate shall able to use modern techniques of Numerical methods, innovative formulas, development, and by pursuing successful careers in Indian and multinational companies. It is well-known that the use of numerical methods for the analysis, simulation, and design of engineering processes and industrial systems has been increasing at a rapid rate. Therefore, this course is intended to better prepare future graduates and computational scientists in understanding the fundamentals of numerical methods, especially their application, limitations, and potentials. This course is designed as an introductory course in computational techniques for solving problems from science with emphasis on applications. The course will cover the classical fundamental topics in numerical methods such as, approximation, solution of nonlinear algebraic systems and solution of ordinary differential equations. The viewpoint will be modern, with connections made between each topic and a variety of applications. By the end of the course, the student should not only be familiar, but more confident, in effectively using numerical tools to solve problems in their own field of interest.

B. Course Outcomes: At the end of the course, students will be able to

[1504.1]	Describe the concept of Numerical methods to find the real roots of algebraic and transcendental equations which enhance their skills to become employable.
[1504.2]	Describe the concept of Numerical methods to solve simultaneous linear algebraic equations and apply to solve the practical problems which makes them employable.
[1504.3]	Evaluate and Analyze the eigenvalue problems using numerical methods.
[1504.4]	Describe the concept of Numerical Methods to solve the ordinary differential equations of first order and apply them to solve practical problems.
[1504.5]	Describe the concept of Finite difference method and apply to evaluate the solution of ordinary differential equations.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1] Critical thinking: Critically interpret data, write reports and apply the basics of evidence.

[PO2] Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO3] Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4] Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5] Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

[PO6] Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7] Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

[**PSO.1**]	To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO.2]	To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3]	To develop creative thinking and the power of imagination
[PSO.4]	To expose the graduates in research in academia and industry for broader applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Online)	20
	Sessional Exam II (Online)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book/Online)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

E. SYLLABUS

Numerical solution of algebraic and transcendental equations: Bisection method; Regula falsi method; Secant method; Iteration method, Convergence of iteration method; Newton-Raphson method; Convergence criteria and order of convergence of all above methods.

Solution of simultaneous linear algebraic equations: Gauss elimination method; Gauss Jordan method; Method of triangularization; Doolittle's method; Crout's method; Cholesky method; Gauss Jacobi method; Gauss Seidel method.

Eigenvalue problems: Power method for numerically extreme eigenvalues and the inverse power methods.

Numerical solution of O.D.E. (for first order only): Picard's method; Euler's method; Modified Euler method; Taylor series method; Milne's predictor corrector formulae; Runge Kutta methods (upto fourth order).

Solution of ordinary differential equations by finite difference method (for second order O.D.E): Finite difference approximations of the derivatives.

F. TEXT BOOKS

1. M. Goyal, Numerical Methods and Statistical Techniques Using 'C', Laxmi Publication, 2009.

2. T. Veerarajan and T. Ramachandran, Numerical Methods: Its Programs in C, Tata McGraw Hill Pub. Co. Ltd, New Delhi, 2005.

G. REFERENCE BOOKS

1. J. G. Kori, Numerical Methods in 'C', Firewall Media, 2002

2. S. Rajasekaran, Numerical Methods in Science and Engineering, S. Chand and Co., 2003.

H. Lecture Plan:

Lecture No.	**Topics**	**Session Objective**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Numerical Methods	Introduction to the course.	Lecture		
2	Numerical solution of algebraic and transcendental equations: Introduction	Knowledge of finding the real roots of algebraic and transcendental equations by numerical methods,	Lecture	**[1504.1]**	Sessional, Assignment, End Term Exam

		convergence of numerical methods.			
3,4	Bisection method	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.1]**	Sessional, Assignment, End Term Exam
5,6	Regula falsi method	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.1]**	Sessional, Assignment, End Term Exam
7	Secant method	Understanding of the method to calculate the solution of the problems and the advantage over the method of false position.	Lecture	**[1504.1]**	Sessional, Assignment, End Term Exam
8	Iteration method	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.1]**	Sessional, Assignment, End Term Exam
9, 10	Newton-Raphson method	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.1]**	Sessional, Assignment, End Term Exam
11, 12	**Problem Discussion (1.1, 1.2)**		Tutorial	**[1504.1]**	
13	**Class Assignment 1**		Assignment	**[1504.1]**	
14	**Solution of simultaneous linear algebraic equations:** Gauss elimination method	Understanding of the methods to find the solution of a system of linear algebraic equations, Gauss Elimination Method.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam
15	Gauss Jordan method	Understanding of the method to find the solution of a system of linear algebraic equations.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam
16	Method of triangularization: Doolittle's method	Understanding of the method to find the solution of a system of linear algebraic equations.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam
17	Crout's method	Understanding of the method to find the solution of a system of linear algebraic equations.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam
18	Cholesky method	Understanding of the method to find the solution of a system of linear algebraic equations.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam

19	Iterative Methods: Gauss Jacobi method	Understanding of the concept of Iterative methods and use them to find the solution of a system of linear algebraic equations.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam
20	Gauss Seidel method	Using method to find the solution of a system of linear algebraic equations.	Lecture	**[1504.2]**	Sessional, Assignment, End Term Exam
21, 22	**Problem Discussion**		Tutorial	**[1504.2]**	
23	**Assignment 2**		Assignment	**[1504.2]**	
24	**Eigenvalue problems**:	Understand the concept of eigenvalues and eigenvectors.	Lecture	**[1504.3]**	
25, 26	Power method for numerically extreme eigenvalues and the inverse power methods	Understanding of the method to find the numerically largest eigen value and the corresponding eigen vector of a square matrix.	Lecture	**[1504.3]**	Sessional, Assignment, End Term Exam
27, 28	**Problem Discussion**		Tutorial	**[1504.3]**	
29	**Assignment 3**		Assignment	**[1504.3]**	
30	**Numerical solution of O.D.E. (first order only):** Picard's method	Understanding of the concept of initial value problem of first order by numerical methods.	Lecture	**[1504.4]**	Sessional, Assignment, End Term Exam
31	Euler's method	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.4]**	Sessional, Assignment, End Term Exam
32	Modified Euler method	Understanding of the difference between Euler's and Modified Euler's method, the advantage of the method and the solution of the problems by the method.	Lecture	**[1504.4]**	Sessional, Assignment, End Term Exam
33	Taylor series method	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.4]**	Sessional, Assignment, End Term Exam
34	Milne's predictor corrector formulae	Understanding of the method to calculate the solution of the problems.	Lecture	**[1504.4]**	Sessional, Assignment, End Term Exam
35	Runge Kutta methods (fourth order)	Understanding of the method of fourth order to calculate the	Lecture	**[1504.4]**	Sessional, Assignment, End Term Exam

		solution of the problems.			
36, 37	**Problem Discussion**		Tutorial	**[1504.4]**	
38	Class Assignment 4		Assignment	**[1504.4]**	
39	Solution of ordinary differential equations by finite difference method (for second order O.D.E)	Understanding of the Finite difference method to find the solution of ordinary differential equations of second order.		**[1504.5]**	Sessional, Assignment, End Term Exam
40	Finite difference approximations of the derivatives.	Understanding of the method to solve Boundary value problems.	Lecture	**[1504.5]**	Sessional, Assignment, End Term Exam
41, 42	**Problem Discussion**		Tutorial	**[1504.5]**	
43	**Class Assignment 5**		Assignment	**[1504.5]**	

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 1504.1	Describe the concept of Numerical methods to find the real roots of algebraic and transcendental equations which enhance their skills to become employable.	3						2	2	3	3	3
MA 1504.2	Describe the concept of Numerical methods to solve simultaneous linear algebraic equations and apply to solve the practical problems which makes them employable.	3						2	3	3	3	3
MA 1504.3	Evaluate and Analyze the eigenvalue problems using numerical methods.	3						2	3	3	3	3
MA 1504.4	Describe the concept of Numerical Methods to solve the ordinary differential equations of first order and apply them to solve practical problems.	3						2	3	3	3	3
MA 1504.5	Describe the concept of Finite difference method and apply to evaluate the solution of ordinary differential equations.	3						2	3	3	3	3

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & statistics
Course Hand-out

Operations Research-I MA 1650 | 4 Credits | 3 1 0 4

Session: Jul 20 – Dec 20 | Faculty: Dr. Himanshu Rathore | Class: B.Sc V Sem (Maths Hons.)

A. **Introduction:** This course is offered by Dept. of Mathematics & Statistics as B. Sc V Sem (Maths Hons.), targeting students who wish to pursue research & development in industries or higher studies in field of Operations Research. The objective of Operations Research, as a mathematical discipline, is to establish theories and algorithms to model and solve mathematical optimization problems that translate to real life decision making problems. The main objective of the course is to develop the ability of the knowledge of operations research and its application in industry, introduce students to practical application of operations research in big mining projects. It involves demonstration of principles and techniques of operations research using real life problems.

B. **Course Outcomes:** At the end of the course, students will be able to

[1650.1]. Learn the applications of, basic methods, and challenges in game theory and employ the concept in their relevant fields.

[1650.2]. Solve mathematical and computational modeling of real decision-making Problems, including the use of modeling tools and computational tools, as well as analytic skills to evaluate the problems.

[1650.3]. Enhance the skill to design, implementation, and analysis of computational experiments.

[1650.4]. Identify and develop Queuing theory models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

The PO's of B.Sc in Mathematics programme are

[PO.1]. Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.

[PO.2]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.3].]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.4]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.

[PO.5]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.6]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

[PO.7].

[PSO.1]. to understand the basic Mathematical & Statistical principles and to explain them clearly.

[PSO.2]. to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

[PSO.3]. to develop creative thinking and the power of imagination.

[PSO.4]. to expose the graduates in research in academia and industry for broader applications.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Open Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Queuing theory: Markovian models – M/M/1, M/M/C (Finite and infinite capacity); M/M/∞ queues (Finite source model); M/G/1 queue (Steady state solutions only). **Game theory:** Games and strategies; Introduction of two person zero sum games; Maximin and minimax principles; Games without saddle point; mixed strategies; Solution of 2 x 2 rectangular games; Graphical method; Dominance property; Algebraic method for m x n games. **PERT/CPM:** Development; Uses and application of PERT/CPM techniques; Network diagram representation; Fulkerson I-J rule for labeling time estimate and determination of critical path on network analysis; PERT techniques; Crashing.

F. Text Books:

- S. D. Sharma, Operations Research, Kedarnath Ramnath, Meerut, 2013.
- Kanti Swarup, P. K. Gupta, and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, India, 1994.

G. Reference Books:

- J. K. Sharma, Operations Research, Macmilan Pub. India Ltd., 2013.
- K. V. Mittal and C. Mohan, Optimization Methods in Operation Research and System Analysis, New Age International Pvt. Ltd., 1996.
- A. Taha, Operations Research- An Introduction, 6th Edition, Prentice Hall of India, 1996.
- V. K. Kapoor, Operations Research, Sultan Chand & Sons., New Delhi, India, 1994.

H. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Introduction to course	Have awareness about course	Lecture	ALL	MTE I ETE
2,3	**Game theory:** Games and strategies	Understanding the concepts	Lecture	MA1650.1	MTE I ETE
4,5	Introduction of two person zero sum games	Discuss the basics of game theory	Lecture	MA1650.1	MTE I Assignment ETE
6,7	Maximin and minimax principles	Learn the concept	Lecture	MA1650.1	MTE I Assignment ETE
8,9,10	Games without saddle point	Understand the concept	Lecture	MA1650.1	MTE I Assignment ETE
11,12,13	Mixed strategies	Practice the problems	Lecture	MA1650.1	MTE I Assignment ETE
14,15	Solution of 2 x 2 rectangular games	Learn the procedure	Lecture	MA1650.1	MTE I Assignment ETE
16,17	Graphical method	Understating the method	Lecture	MA1650.1	MTE I Assignment ETE
18,19	Dominance property	Practice the dominance principle	Lecture	MA1650.1	MTE I Assignment ETE
20,21	Algebraic method for m x n games	Learn the problems related to theorem	Lecture	MA1650.1	MTE I Quiz ETE
22,23	**PERT/CPM:** Development	Understanding the techniques	Lecture	MA1650.3	MTE I Quiz ETE
24,25	Uses and application of PERT/CPM techniques	Learn use of techniques	Lecture	MA1650.3	MTE I Quiz ETE
26,27	Network diagram representation	Demonstrate the network diagram	Lecture	MA1650.3	MTE I Quiz ETE
28,29	Fulkerson I-J rule for labeling time estimate	Learn the properties	Lecture	MA1650.3	MTE I Quiz ETE
30,31	Determination of critical path on network analysis	Practice the problems	Lecture	MA1650.3	MTE I Quiz ETE
32,33	PERT techniques	Learn to practice problems related to PERT	Lecture	MA1650.3	MTE I Assignment ETE
34,35	Crashing	Understating the concept	Lecture	MA1650.3	MTE I Assignment ETE
36,37	Introduction: Markovian models	Learn the modelling	Lecture	MA1650.2.4	MTE II Assignment ETE
38,39	M/M/1 model	Understand the concept of model	Lecture	MA1650.2.4	MTE II Assignment

					ETE
40,41,42	M/M/1 related problems	Learn the modelling	Lecture	MA1650.2.4	MTE II Assignment ETE
43,44	M/M/C (Finite capacity)	Understand the concept of model	Lecture	MA1650.2.4	MTE II Assignment ETE
45,46	M/M/C related problems	Learn the modelling	Lecture	MA1650.2.4	MTE I ETE
47,48	M/M/C (infinite capacity)	Understand the concept of model	Lecture	MA1650.2.4	MTE II Assignment ETE
49,50	M/M/C related problems	Learn the modelling	Lecture	MA1650.2.4	Quiz Assignment ETE
51	M/M/∞ queues (Finite source model)	Understand the concept of model	Lecture	MA1650.2.4	Quiz Assignment ETE
52	M/M/∞ related problems	Learn the modelling	Lecture	MA1650.2.4	Quiz Assignment ETE
53	M/G/1 queue (Steady state solutions only).	Understand the concept of model	Lecture	MA1650.2.4	Quiz Assignment ETE
54	M/G/1 related problems	Learn the modelling	Lecture	MA1650.2.4	Quiz Assignment ETE

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 1650.1	Learn the applications of, basic methods, and challenges in game theory and employ the concept in their relevant fields.	3							3	3		
MA 1650.2	Solve mathematical and computational modeling of real decision-making Problems, including the use of modeling tools and computational tools, as well as analytic skills to evaluate the problems.		2	2					3	3		
MA 1650.3	Enhance the skill to design, implementation, and analysis of computational experiments.				2	2			3	3		
MA 1650.4	Identify and develop Queuing theory models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems.						2		3	3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

ECONOMETRICS | MS1505 | 3 Credits | 2 1 0 3

Session: July 20 – Dec 20 | Faculty: **Dr. Ashish Kumar** | Class: B.Sc. /B.A. V Sem.

A. Introduction:-

Econometrics is concerned with the statistical and mathematical tools in economic scenario. It is an important subject and step in all spheres of data analysis. The course aims at providing the basics of econometric with emphasis on some commonly statistical techniques like correlation, regression, autocorrelation, etc.

B. Course Outcomes: At the end of the course, students will be able to

1505.1	Interpret and illustrate the concept of bivariate data to find the relation between variables
1505.2	Describe the conceptual framework of predication for dependent variables
1505.3	Understand conceptual framework of simple linear regression models.
1505.4	Recall conceptual framework of OLS estimation and autocorrelation.
1505.5	Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.
PSO.2	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
PSO.3	to develop creative thinking and the power of imagination.
PSO.4	to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Bivariate Data: Scatter diagram, correlation, product moment correlation coefficient and their uses, rank correlation, concept of multiple correlation and partial correlation in case of three variables. Regression Analysis. **Introduction:** Definition and scope of econometrics, methodology of econometric research. **Simple Linear Regression Model:** Assumptions, estimation (through OLS method), desirable properties of estimators, Gauss- Markov theorem, interpretation of regression coefficients, testing of regression coefficients, test for regression as a whole, coefficient of determination. **Problems in OLS Estimation:** Problems of heterosedasticity. **Autocorrelation:** concept, consequences of autocorrelated disturbances, detection of autocorrelation, their estimation and testing, estimation using Durbin-Watson statistic, forecasting, exponential smoothing for linear trend model.

F. TEXT BOOKS:-

1. Singh , S.P., Parashar, A.K, and Singh, H.P., Econometrics, S. Chand and Company Ltd, New Delhi, 1984.
2. Gujarati, D.N., Basic Econometrics, Fourth Edition (McGraw−Hill), New Delhi, 2004.

G. REFERENCE BOOKS:-

1. Greene, W. , Econometric Analysis, Prentice Hall, New York, 1997.
2. Griffith, W.F., R.H. Hill and G.G. Judge, Learning and Practicing Econometrics, john Wiley,New York, 1993.
3. Johnston, J., Econometric Methods, McGraw Hill, New York, 1985.
4. Johnston, J. and Nardo, J.D., Econometric Methods, McGraw Hill, New York, 1997.
5. Mmenta, J., Elements of Econometrics, Michigan Press, New York, 1997.
6. Koutsoyiannis, A., Theory of Econometrics, (2nd Edition), The Macmillan Press Ltd., Hampshire, 1977.
7. Maddala, G.S., Econometrics – An Introduction, McGraw Hill, New York, 1993.

H. Lecture Plan:-

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1,2	**Bivariate Data:** Scatter diagram, correlation and their uses	illustrate the concept of bivariate data	Lecture	1505.1	Home Assignment Class Quiz Mid Term I End Term
3,4	product moment correlation coefficient and rank correlation	Understand the relation between variables	Lecture	1505.1	Home Assignment Class Quiz Mid Term I End Term
5,6	Multiple correlation in case of three variables.	Can handle the multivariate data	Lecture	1505.1	In Class Quiz Mid Term I End Term
7,8,9,10	Partial correlation in case of three variables.	Can handle the multivariate data	Lecture	1505.1	Home Assignment Mid Term I End Term
11	Regression Analysis	Describe the conceptual framework of predication	Lecture	1505.2	In Class Quiz Mid Term I End Term
12,13,14	**Introduction:** Definition and scope of econometrics, methodology of econometric research.	Introduction to econometrics	Lecture	1505.2	Class Quiz Mid Term I End Term
15,16	**Simple Linear Regression Model:** Assumptions, estimation (through OLS method), desirable properties of estimators	Describe properties of OLS	Lecture	1505.2	Class Quiz Mid Term I End term
17,18,19, 20	Gauss- Markov theorem,	Understand the framework of BLUE	Lecture	1505.2	Home Assignment Class Quiz Mid Term I End Term
21,22	interpretation of regression coefficients, testing of regression coefficients, test for regression as a whole,	Understand concepts of inference in OLS	Lecture	1505.3	Class Quiz Mid Term II End Term
23,24	Coefficient of determination.	Understand concepts of inference in OLS	Lecture	1505.3	Class Quiz Mid Term II End Term
25,26,27	**Problems in OLS Estimation:** Problems of heterosedasticity.	Understand concepts of inference in OLS	Lecture	1505.3	Class Quiz Mid Term II End Term

28,29	**Autocorrelation:** concept, consequences of auto correlated disturbances	Understand relationship between OLS estimation and autocorrelation.	Lecture	1505.4	Class Quiz Mid Term II End Term
30,31	detection of autocorrelation, their estimation and testing,	Understand relationship between OLS estimation and autocorrelation.	Lecture, Activity	1505.4	Class Quiz Mid Term II End Term
32,33, 34,35	Estimation using Durbin-Watson statistic	Understand relationship between OLS estimation and autocorrelation.	Lecture, Activity	1505.5	Class Quiz End Term
36	Forecasting, exponential smoothing for linear trend model.	Understand relationship between OLS estimation and autocorrelation.	Lecture	1505.5	Class Quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1505.1	Interpret and illustrate the concept of bivariate data to find the relation between variables	**2**			**2**			**3**				
MS1505.2	Interpret and illustrate the concept of bivariate data to find the relation between variables		**2**	**3**		**2**						
MS1505.3	Interpret and illustrate the concept of bivariate data to find the relation between variables	2		**3**			**1**					
MS1505.4	Interpret and illustrate the concept of bivariate data to find the relation between variables		**3**		**2**			**3**				
MS1505.5	Interpret and illustrate the concept of bivariate data to find the relation between variables	**2**		**2**			**2**					

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

STATISTICAL INFERENCE: TESTING OF HYPOTHESIS | MS1506| 3 Credits | 2 1 0 3

Session: August 20 – December 20 | Faculty: **Dr. Monika Saini** | Class: B.Sc. /B.A. V Sem.

A. Introduction:-

Hypothesis testing is concerned with statistical testing of postulates (usually concerning parameters) in an empirical way, i.e., from data. It is an important subject and step in all spheres of data analysis. The course aims at providing the basics of hypothesis testing with emphasis on some commonly encountered hypothesis tests in statistical data analysis such as in comparisons of averages, testing for variability, proportions and significance testing in regression analysis

B. Course Outcomes: At the end of the course, students will be able to

[1506.1]	Understand the concept of statistical decision theory
[1506.2]	Understand conceptual framework of likelihood tests
[1506.3]	Understand conceptual framework of sampling distributions and their implementation
[1506.4]	Understand conceptual framework of tests of significance.
[1506.5]	Understand the framework of non-parametric test for increasing data analysis skills for employability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.
PSO.2	to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
PSO.3	to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Elements of Statistical Decision Theory: Neymann theory of testing of hypotheses, simple and composite hypotheses, null and alternative hypotheses, two types of errors, critical region, level of significance, power of the test, unbiased tests, N-P lemma, construction of most powerful test, uniformly most powerful test, uniformly most powerful unbiased test. **Likelihood Ratio Test:** Likelihood ratio test and its applications, asymptotic distribution of LR statistic and asymptotic power of LR tests. **Sampling Distributions:** Chi-square, Student's t and Seducer's F, Fisher's-Z distribution and their applications. **Tests of Significance:** tests of significance based on t, F and Chi-square distributions. **Non-Parametric Tests:** Empirical distribution function, one sample and two-sample sign test. Wald-Wolfowitz run test, run test for randomness, Median test, Wilcoxon-Mann-Whitney U-test, Kolmogorov-Smirnov one-sample test, Kruskal-Wallis test.

TEXT BOOKS:-

1. Goon, A.M., Gupta, M.K. and Dasgupta, B., An Outline of Statistical Theory, Vol. II, 3rd Edn. World Press, Kolkata, 2005.
2. Kendall and Stuart, Advanced Theory of Statistics Vol.-II, Charles Griffin & Co. Ltd. London, 1961.

REFERENCE BOOKS:-

1. Casella, G. and Berger, R.L., Statistical Inference, Second Edn. Thomson Duxbury, 2002.
2. Hogg, R.V. and Tanis, E.A., Probability and statistical inference, 3rd Edn. Macmillan Publishing Co. Inc., 1988.
3. Rohatgi, V. K., Statistical Inference, John Wiley and Sons, 1984.

4. Mukhopadhyay, P., Applied Statistics, Books & Allied (P) Ltd., 2011.

F. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	**Elements of Statistical Decision Theory:** Neymann theory of testing of hypotheses	Understand the concept of statistical decision theory	Lecture	1506.1	Home Assignment Class Quiz Mid Term I End Term
2,3	simple and composite hypotheses, null and alternative hypotheses, two types of errors, critical region, level of significance	Understand the concept of statistical decision theory	Lecture	1506.1	Home Assignment Class Quiz Mid Term I End Term
4,5	power of the test, unbiased tests, N-P lemma, construction of most powerful test, uniformly most powerful test, uniformly most powerful unbiased test.	Understand the concept of statistical decision theory	Lecture	1506.1	In Class Quiz Mid Term I End Term
6,7	**Likelihood Ratio Test:** Likelihood ratio test and its applications,	Understand conceptual framework of likelihood tests	Lecture	1506.2	In Class Quiz Mid Term I End Term
8,9	asymptotic distribution of LR statistic and asymptotic power of LR tests	Understand conceptual framework of likelihood tests	Lecture	1506.2	Class Quiz Mid Term I End Term
10, 11	**Sampling Distributions:** Chi-square distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	1506.3	Class Quiz Mid Term I End term

12	Student's t distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	1506.3	Class Quiz Mid Term I End Term
13,14	Seducer's F distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	1506.3	Class Quiz Mid Term I End Term
15,16	Fisher's-Z distribution and their applications.	Understand conceptual framework of sampling distributions and their implementation	Lecture	1506.3	Class Quiz Mid Term I End Term
17,18	**Tests of Significance:** tests of significance based on t	Understand conceptual framework of tests of significance.	Lecture, Activity	1506.4	Class Quiz End Term Mid Term I
19,20	tests of significance based on Z	Understand conceptual framework of tests of significance.	Lecture	1506.4	Class Quiz End Term Mid Term I
21,22	tests of significance based on F	Understand conceptual framework of tests of significance.	Lecture	1506.4	Class Quiz Mid Term II End Term
23,24	tests of significance based on Chi Square	Understand conceptual framework of tests of significance.	Lecture	1506.4	Class Quiz Mid Term II End Term
25,26	**Non-Parametric Tests:** Empirical distribution function, one sample and two-sample sign test.	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	1506.5	Class Quiz Mid Term II End Term
27,28	Wald-Wolfowitz run test, run test for randomness,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	1506.5	Class Quiz Mid Term II End Term
29,30	Median test,	Understand the framework of non-	Lecture	1506.5	Class Quiz Mid Term II End Term

		parametric test for increasing data analysis skills for employability .			
31,32	Wilcoxon-Mann-Whitney U-test,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	1506.5	Class Quiz Mid Term II End Term
33,34	Kolmogorov-Smirnov one-sample test,	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	1506.5	Class Quiz Mid Term II End Term
35,36	Kruskal-Wallis test	Understand the framework of non-parametric test for increasing data analysis skills for employability .	Lecture	1506.5	Class Quiz Mid Term II End Term

G. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1506.1	Understand the concept of statistical decision theory	**2**			**2**			**3**				
MS1506.2	Understand conceptual framework of likelihood tests		**2**	**3**		**2**						
MS1506.3	Understand conceptual framework of sampling distributions and their implementation	2		**3**			**1**					
MS1506.4	Understand conceptual framework of tests of significance		**3**		**2**			**3**				
MS1506.5	Understand the framework of non-parametric test for increasing data analysis skills.	**2**		**2**			**2**					

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

H. Course Outcome Attainment Level Matrix:-

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%							ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1506.1	Understand the concept of statistical decision theory											
MS1506.2	Understand conceptual framework of likelihood tests											
MS1506.3	Understand conceptual framework of sampling distributions and their implementation											
MS1506.4	Understand conceptual framework of tests of significance											
MS1506.5	Understand the framework of non-parametric test for increasing data analysis skills.											

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Physics

Course Hand-out

Basic Electronics | PY1511 | 4 Credits | 2 1 0 3

Session: July 20 – Dec. 20 | Faculty: Dr. Uvais VN | Class: B Sc V Sem (Pass)

A. Introduction: The course will cover a broad range of material related to advanced electronics including p-n junction devices and applications of linear and digital IC's. Both the theoretical and practical aspects of circuit design will be emphasized, and the course will serve as an introduction to a range of advanced topics in electronics. Another goal of this course is to familiarise the students with the physics related to the p-n junction devices. The approach, chosen to significantly boost understanding of the p-n junction physics and critical skills of the students in circuit designing include a careful analysis of design parameters, determination of the criteria for active and passive component selection and final circuit implementation

B. Course Outcomes: At the end of the course, students will be able to

[PY1511.1] Impart knowledge of semiconductor junction and solid state devices
[PY1511.2] Acquire knowledge of diodes and bipolar junction transistors.
[PY1511.3] Demonstrate different properties of field effect transistor.
[PY1511.4] Elucidate and design the digital circuits and logic gates
[PY1511.5] Acquire knowledge of digital logic levels and application of the knowledge to understand, analyse and design various combinational, sequential digital electronic circuits and enhance the skill and employability.

B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

A. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Close Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

C. SYLLABUS

Solid State Devices: Semiconductors: Intrinsic semiconductors, electrons and holes, Fermi Level, Temperature dependence of electron and hole concentrations, Doping; Impurity states, n and p type semiconductors, conductivity, mobility, Hall effect, Hall coefficient. Semiconductor devices: Metal-semiconductor junction, p-n junction, majority and minority carriers in diode, Zener and tunnel diodes, light emitting diode, laser diode, solar cell.
Electronics: Diodes and its application: Diode as a circuit element, load line concept, rectification, ripple factor, Zener diode, voltage stabilization, IC voltage regulation. Bipolar Junction Transistor: n-p-n and p-n-p transistor, characteristics of transistor in CB, CE and CC mode. Graphical analysis of the CE configuration, current gains (α, β and γ), transistor biasing (fixed and voltage divider) and stabilization, thermal runway, low frequency equivalent circuits, h- parameters. Field effect transistors: JFET volt-ampere curves, source follower, Depletion and enhancement mode, MOSFET. Digital Circuits and logic gates: binary systems and numbers, decimal to binary and reverse conversion, binary addition and subtraction, OR, AND, NOT gates, truth tables, de-Morgan's theorem, NOR and NAND universal gates.

Text Books:

T1. Mehta V K and Mehta R, Principles of Electronics, S. Chand (2005).
T2. Bhargava N N, Kulshreshtha D C and Gupta S C, Basic Electronics and Linear Circuits, McGraw Hill (2013).
T3. Chattopadhyay D and Rakshit P C, Electronic Fundamental and Applications, New Age International (2008).

Reference Books:

R1. Boylestad R L and Nashelsky L, Electronic Devices and circuit theory, Pearson India (2009).
R2. Streetman B G and Banerjee S K Solid State Electronic Devices, Prentice Hall of India, New Delhi (2014).
R3. Milman J and Halkias C, Integrated Electronics, McGraw Hill (1989).
R4. Ryder J D, Electronic Fundamentals and Applications, Prentice Hall of India, New Delhi (2009).
R5. Millman J and Gabriel A, Microelectronics, International Ed., McGraw Hill Book Company, New York (2001).
R6. Malvino A P and Leach D P, Digital Principles and applications, McGraw Hill (1986).
R7. Floyd T L, Digital Fundamentals, Pearson (2011).

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D. Lecture Plan:

Lecture no	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the outcomes
1.	Introduction to lecture plan	NA	**Lecture**	**NA**	NA
2.	Semiconductors, Intrinsic semiconductors	Solid State Devices:	Flipped Classroom, Lecture	**PY1511.1**	MTE 1, Assignment, Quiz, ETE
3.	Electrons and holes, Fermi Level,	Solid State Devices:	**Lecture**	**PY1511.1**	MTE 1, Assignment, Quiz, ETE
4.	Temperature dependence of electron and hole concentrations	Solid State Devices:	**Lecture**	**PY1511.1**	MTE 1, Assignment, Quiz, ETE
5.	Doping; Impurity states, n and p type semiconductors	Solid State Devices:	Flipped Classroom, Lecture	**PY1511.1**	MTE 1, Assignment, Quiz, ETE
6.	conductivity, mobility, Hall effect,Hall coefficient	Solid State Devices:	Flipped Classroom, Lecture	**PY1511.1**	MTE 1, Assignment, Quiz, ETE
7.	Tutorial 1	Solid State Devices:	Activity (Think Pair Share)	**PY1511.1**	Problem Practice
8.	Semiconductor devices: Metal-semiconductor junction, p-n junction	Solid State Devices:	**Lecture**	**PY1511.1**	In First Sessional, Assignment, Class Quiz, End term Exam
9.	majority and minority carriers in diode, Zener and tunnel diodes	Solid State Devices:	**Lecture**	**PY1511.1**	In First Sessional, Assignment, Class Quiz, End term Exam
10.	light emitting diode, laser diode, solar cell.	Solid State Devices:	Flipped Classroom, Lecture	**PY1511.1**	In First Sessional, Assignment, Class Quiz, End term Exam
11.	Diodes and its application: Diode as a circuit element	Electronics	**Lecture**	**PY1511.1**	In First Sessional, Assignment, Class Quiz, End term Exam
12.	load line concept, rectification, ripple factor	Electronics	Flipped Classroom, Lecture	**PY1511.1**	In First Sessional, Assignment, Class Quiz, End term Exam

13.	Zener diode, voltage stabilization,	Electronics	**Lecture**	**PY1511.2**	In First Sessional, Assignment, Class Quiz, End term Exam
14.	IC voltage regulation. Bipolar Junction Transistor: n-p-n and p-n-p transistor	Electronics	**Lecture**	**PY1511.2**	In First Sessional, Assignment, Class Quiz, End term Exam
15.	characteristics of transistor in CB, CE and CC mode	Electronics	**Lecture**	**PY1511.2**	In First Sessional, Assignment, Class Quiz, End term Exam
16.	Graphical analysis of the CE configuration, current gains (α, β and γ)	Electronics	**Lecture**	**PY1511.2**	In First Sessional, Assignment, Class Quiz, End term Exam
17.	transistor biasing (fixed and voltage divider) and stabilization	Electronics	Flipped Classroom, Lecture	**PY1511.3**	In First Sessional, Assignment, Class Quiz, End term Exam
18.	Tutorial 2	Electronics	Activity (Think Pair Share)	**PY1511.3**	Problem Practice
19.	thermal runway, low frequency equivalent circuits	Electronics	Flipped Classroom, Lecture	**PY1511.3**	In First Sessional, Assignment, Class Quiz, End term Exam
20.	h- parameters	Electronics	**Lecture**	**PY1511.3**	In First Sessional, Assignment, Class Quiz, End term Exam
21.	JFET volt-ampere curves, source follower	Understand Field effect transistors	**Lecture**	**PY1511.3**	In First Sessional, Assignment, Class Quiz, End term Exam
22.	Depletion and enhancement mode	Understand Field effect transistors	**Lecture**	**PY1511.3**	In First Sessional, Assignment, Class Quiz, End term Exam
23.	MOSFET	Understand Field effect transistors	**Lecture**	**PY1511.3**	In First Sessional, Assignment,

					Class Quiz, End term Exam
24.	binary systems and numbers	Understand digital Circuits and logic gates	Flipped Classroom, Lecture	**PY1511.4 &5**	In First Sessional, Assignment, Class Quiz, End term Exam
25.	decimal to binary and reverse conversion	Understand digital Circuits and logic gates	Flipped Classroom, Lecture	**PY1511.4 &5**	In First Sessional, Assignment, Class Quiz, End term Exam
26.	binary addition and subtraction	Understand digital Circuits and logic gates	**Lecture**	**PY1511.4 &5**	In second Sessional, Assignment, Class Quiz, End term Exam
27.	OR, AND, NOT gates	Understand digital Circuits and logic gates	**Lecture**	**PY1511.4 &5**	In second Sessional, Assignment, Class Quiz, End term Exam
28.	Tutorial 3	Understand digital Circuits and logic gates	**Lecture**	**PY1511.4 &5**	Problem Practice
29.	truth tables, de-Morgan's theorem	Understand digital Circuits and logic gates	**Lecture**	**PY1511.4 &5**	In second Sessional, Assignment, Class Quiz, End term Exam
30.	NOR and NAND universal gates.	Understand digital Circuits and logic gates	**Lecture**	**PY1511.4 &5**	In second Sessional, Assignment, Class Quiz, End term Exam
31.	Tutorial 4	Understand digital Circuits and logic gates	Activity (Think Pair Share)	**PY1511.4 &5**	Problem Practice
32.	Tutorial 5	NA	Activity (Think Pair Share	**PY1511.6**	In Assignment, Class Quiz, End term Exam

E. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
PY 1511.1	Understand the concept of semiconductor junction and solid state devices	1					1		1	1		
PY 1511.2	Compare and identify diodes and bipola junction transistors.	3				2				3		
PY 1511.3	Demonstrate different properties of field effect transistor.	2								2		
PY 1511.4	Elucidate and design the digital circuits and logic gates	3					2			3		
PY 1511.5	Acquire knowledge of digital logic levels and application of the knowledge to understand, analyse and design various combinational, sequential digital electronic circuits and enhance the skill and employability	3					2			3		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR
School of Basic Sciences

Department of Physics
Course Hand-out

Solid state physics| PY 1512 | 3 Credits | 2 1 0 3

Session: Aug 20 – Nov 20 | Faculty: Dr. Anupam Sharma | Class: B.Sc. V Sem.

A. **Introduction:** Solid state physics is the branch of physics in which we study how the macroscopic properties of material result from their microscopic properties. In solid state of matter, the arrangement of atoms forms different structure of materials. The structure of materials is the key deciding factor for different kind of properties, such as thermal, electrical, optical, magnetic, dielectric etc. In this course we will learn the structure of solid materials and their different physical properties along with underlying physics.

B. **Course Outcomes:** At the end of the course, students will be able to

[PY 1512.1] develop a clear concept of the crystal classes and symmetries.
[PY 1512.2] analyse the Braggs conditions for X-ray diffraction in crystals.
[PY 1512.3] distinguish the various bonding, optical and acoustic phenomenon.
[PY 1512.4] develop basic knowledge of free-electron model for metals.
[PY 1512.5] examine the basic properties of superconductors in the framework of BCS theory.
[PY 1512.6] explain the magnetic properties of materials which will enhance their employability skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1] To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO2] To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3] To develop creative thinking and the power of imagination.
[PSO.4] To expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Close Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Crystal structure and binding Fundamental Lattice systems, Simple crystal structures- SC, FCC, BCC & HCP. X-ray diffraction, Bragg's law, Miller indices and determination of cell constants, types of bonding, cohesive energy and compressibility of ionic crystals. **Thermal Properties and Band theory of solids** Introduction to lattice vibrations and concept of phonons, Debye model for the heat capacity of solids, contribution from electron gas in metals. Thermal conductivity of metals, formation of bonds (qualitative discussion); periodic potential and Bloch function, dispersion relation inside a band (no derivation) leading to the concept of band shapes; effective mass of an electron; occupation of band by electrons, conductors, semi-conductors and insulators. **Superconductivity** Definition, Critical Parameters, Meissner effect, Josephson's effect, Type- I and Type- II Superconductors, London Theory, BCS Theory (Qualitative only), High Temperature Superconductivity, Applications of Superconductivity. **Magnetism** Diamagnetism, Quantum Theory of Diamagnetism, Paramagnetism, Superparamagnetism, Ferromagnetism, Antiferromagnetism, and Ferrimagnetism, Hysteresis loop and its significance.

F. TEXT BOOKS

T1. Pillai S O, Solid State Physics, New Age International (2015).
T2. Ali Omer M, Elementary Solid State Physics, Pearson Education (2002).
T3. Kittel C, Introduction to Solid State Physics, Wiley India (2012).

G. REFERENCE BOOKS

R1. Raghavan V, Material Science and Engineering, PHI (2004).
R2. Puri R K and Babbar V K, Solid State Physics, S. Chand (2010).
R3. Dekker A.J, Solid State Physics, McMillan, India, (2000).
R4. Epifanov G.I, Solid State Physics, Mir Publisher, (1979).

H. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Introduction of solid state physics	Understanding of concept of the crystal classes and symmetries	Lecture	**PY1512.1**	MTE 1 ETE
2	Simple crystal structures- SC, FCC, BCC & HCP	Understanding of concept of the crystal classes and symmetries	Lecture	**PY1512.1**	MTE 1 ETE
3	X-ray diffraction	Application of Braggs conditions in crystals	Lecture	**PY1512.2**	MTE 1 ETE
4	Bragg's law	Application of Braggs conditions in crystals	Lecture	**PY1512.2**	MTE 1 ETE
5	Miller indices and determination of cell constants	Understanding of concept of the crystal classes and symmetries	Lecture	**PY1512.1 PY1512.2**	MTE 1 ETE
6	types of bonding	Understanding of bonding, optical and acoustic phenomenon	Lecture	**PY1512.3**	MTE 1 ETE
7	cohesive energy	Understanding of bonding, optical and acoustic phenomenon	Tutorial	**PY1512.3**	MTE 1 ETE
8	compressibility of ionic crystals	Understanding of bonding, optical and acoustic phenomenon	Lecture	**PY1512.3**	MTE 1 assignment/Quiz ETE
9	**Tutorial – I (Numerical Problems)**	Understanding of bonding, optical and acoustic phenomenon	Tutorial	**PY1512.3**	MTE assignment/Quiz ETE
10	Introduction to lattice vibrations	Understanding of bonding, optical and acoustic phenomenon	Lecture	**PY1512.3**	MTE assignment/Quiz ETE

11	concept of phonons	Understanding of bonding, optical and acoustic phenomenon	Lecture	**PY1512.3**	MTE 2 ETE
12	Debye model for the heat capacity of solids	Understanding of bonding, optical and acoustic phenomenon	Tutorial	**PY1512.3**	MTE 2 ETE
13	contribution from electron gas in metals	Knowledge of free-electron model for metals	Lecture	**PY1512.3**	MTE 2 ETE
14	Thermal conductivity of metals	Knowledge of free-electron model for metals	Lecture	**PY1512.3**	MTE 2 ETE
15	formation of bonds (qualitative discussion)	Knowledge of free-electron model for metals	Lecture	**PY1512.3**	MTE 2 ETE
16	periodic potential and Bloch function	Knowledge of free-electron model for metals	Tutorial	**PY1512.4**	MTE 2 ETE
17	dispersion relation inside a band (no derivation)	Knowledge of free-electron model for metals	Lecture	**PY1512.4**	MTE 2 ETE
18	concept of band shapes	Knowledge of free-electron model for metals	Lecture	**PY1512.4**	MTE Assignment/Quiz ETE
19	effective mass of an electron	Knowledge of free-electron model for metals	Lecture	**PY1512.4**	MTE Assignment/Quiz ETE
20	occupation of band by electrons	Knowledge of free-electron model for metals	Tutorial	**PY1512.4**	MTE 2 ETE
21	conductors, semi-conductors and insulators	Knowledge of free-electron model for metals	Lecture	**PY1512.4**	MTE 2 ETE
22	**Tutorial – II (Numerical Problems)**	Knowledge of free-electron model for metals	Tutorial	**PY1512.4**	MTE Assignment ETE

23	Introduction of superconductivity	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
24	Critical Parameters	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
25	Meissner effect,	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
26	Josephson's effect	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
27	Type- I and Type- II Superconductors	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
28	London Theory	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
29	BCS Theory (Qualitative only)	Basic properties of superconductors	Tutorial	**PY1512.5**	ETE
30	High Temperature Superconductivity	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
31	Applications of Superconductivity	Basic properties of superconductors	Lecture	**PY1512.5**	ETE
32	**Tutorial – III (Numerical Problems)**	Basic properties of superconductors	Tutorial	**PY1512.5**	ETE
33	Diamagnetism	Understanding of magnetic properties of materials	Lecture	**PY1512.6**	ETE
34	Quantum Theory of Diamagnetism	Understanding of magnetic properties of materials	Lecture	**PY1512.6**	ETE
35	Paramagnetism, Superparamagnetism	Understanding of magnetic properties of materials	Tutorial	**PY1512.6**	ETE

36	Ferromagnetism	Understanding of magnetic properties of materials	Lecture	**PY1512.6**	ETE
37	Antiferromagnetism	Understanding of magnetic properties of materials	Lecture	**PY1512.6**	ETE
38	Ferrimagnetism	Understanding of magnetic properties of materials	Lecture	**PY1512.6**	ETE Assignment/Quiz
39	Hysteresis loop and its significance.	Understanding of magnetic properties of materials	Lecture	**PY1512.6**	ETE
40	**Tutorial – IV (Numerical Problems)**	Understanding of magnetic properties of materials	Tutorial	**PY1512.6**	ETE

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
PY 1512.1	develop a clear concept of the crystal classes and symmetries.	1	2			2		2	1	2	2	2
PY 1512.2	analyse the Braggs conditions for X-ray diffraction in crystals.	1				1		1			2	
PY 1512.3	distinguish the various bonding, optical and acoustic phenomenon.	1	1			1					2	
PY 1512.4	develop basic knowledge of free-electron model for metals.	1	1			1		2			2	2
PY 1512.5	examine the basic properties of superconductors in the framework of BCS theory.	1			1			1			3	
PY 1512.6	explain the magnetic properties of materials which will enhance their employability skills.	1	2					2	1			

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of School of Basic Science

Department of Mathematics and Statistics
Course Hand-out

Complex Analysis | MA1601 | 4 Credits | 3 1 0 4

Session: Jan 21 – May 21 | Faculty: Dr. Pooja Sharma | Class: B. Sc. (Hons) Mathematics

A. Introduction: This course is aimed to provide an introduction to the theories for functions of a complex variable. It begins with the exploration of the algebraic, geometric and topological structures of the complex number field. The concepts of analyticity, Cauchy-Riemann relations and harmonic functions are then introduced. The notion of the Riemann sheet is presented to help student visualize multi-valued complex functions. Complex integration and complex power series are presented. We then discuss the classification of isolated singularities and examine the theory and illustrate the applications of the calculus of residues in the evaluation of integrals. Students will be equipped with the understanding of the fundamental concepts of complex variable theory. In particular, students will acquire the skill of contour integration to evaluate complicated real integrals via residue calculus. The prerequisites are some knowledge of calculus (up to line integrals and Green's theorem), and some basic familiarity with differential equations would be useful.

B. Course Outcomes: At the end of the course, students will be able to :

[1601.1]. understand the importance and significance of differentiability for complex functions and be familiar with the Cauchy-Riemann equations

[1601.2] Use the general Cauchy integral theorem to get parameterizations of curves, and compute line integrals which enhance their problem-solving skills.

[1601.3] Expand the function in terms of power series. Define singularities of a function, know the different types of singularities, and be able to determine the points of singularities of a function.

[1601.4] Use the residue theorem to compute several kinds of real integrals.

[1601.5] Construct conformal mappings and transformations between many kinds of domain which makes them employable.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (Summative)	Sessional Exam I	15
	Sessional Exam II	15
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	30
End Term Exam (Summative)	End Term Exam	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Complex Numbers and Functions: Limit; Continuity and differentiability of complex functions; Analytic functions; Cauchy-Riemann equations; Harmonic functions; Contours; Line integrals; Cauchy's integral theorem and its direct consequences; Cauchy's integral formula for the functions and derivatives; Morera's theorem; Applications to the evaluation of simple line integrals; Cauchy's

inequality; Liouville's theorem; Fundamental theorem of algebra. Power series: Taylors series; Laurent's series; Circle and radius of convergence; Sum functions. Singularities and residues: Isolated singularities (Removable singularity, pole and essential singularity); Residues; Residue theorem. Real definite integrals: Evaluation using the calculus of residues; Integration on the unit circle. Transformations: Definition of conformal mapping; Bilinear transformation; Cross-ratio; Properties; Inverse points; Elementary transformations e.g. the function

Text Books:

1. A. R. Vashishtha, Complex Analysis, Krishna Prakashan, Meerut, 2013.

2. R. V. Churchill and J. W. Brown, Complex Variables and Applications, 5th Edition, McGraw Hill Co., 2013.

Reference Books:

1. L. V. Ahlfors, Complex Analysis, Tata McGraw Hill, 3rd Edition, 2013.

2. S. Ponnusamy, Foundation of Complex Analysis, Narosa Pub. House, 2nd Edition, 2010.

F. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Complex Numbers and Functions: Introduction	Basic Knowledge of Complex variable and Functions	Lecture	1601.1	Mid Term 1 End term
2, 3, 4	Analytic functions	Understanding of Analytic Functions	Lecture	1601.1	Mid Term 1 End term
5	Cauchy-Riemann equations	Understanding of Properties of Analytic Functions	Lecture	1601.1	Mid Term 1 End term
6,7	Harmonic functions	Understanding of Properties of Analytic Functions	Lecture	1601.1	Mid Term 1 End term
8,9,10	Contours; Line integrals	Basic Knowledge of Line Integrals	Lecture	1601.2	Mid Term 1 End term
11, 12,13	Cauchy's integral theorem and its direct consequences	Understanding of Cauchy's Integral theorem to evaluate integrals	Lecture	1601.2	Mid Term 1 End term
14	Cauchy's integral formula for the functions and derivatives	Understanding of Cauchy's Integral Formula to evaluate integrals	Lecture	1601.2	Mid Term 1 End term
15, 16	Morera's theorem and problems	Understanding of Morera's Theorem	Lecture	1601.2	Mid Term 1 End term
17, 18	Applications to the evaluation of simple line integrals	Understanding of Properties of Morera's Theorem	Lecture	1601.2	Mid Term 1 End term
19	Cauchy's inequality	Understanding of Cauchy's Inequality	Lecture	1601.2	Mid Term 1 End term
20, 21	Liouville's theorem and Problems	Understanding of Liouville's theorem	Lecture	1601.2	Mid Term 1 End term

22, 23	Fundamental theorem of algebra	Understanding of Fundamental theorem of algebra	Lecture	1601.2	Mid Term 1 End term
24, 25	Power series: Taylors series	Basic Knowledge of Power Series	Lecture	1601.3	Mid Term II End term
26	Laurent's series	Basic Knowledge of Power Series	Lecture	1601.3	Mid Term II End term
27, 28	Circle and radius of convergence; Sum functions	Understanding of Properties Complex Functions	Lecture	1601.3	Mid Term II End term
39, 30, 31	Singularities and residues: Isolated singularities (Removable singularity)	Basic Knowledge of Singularities and Residues	Lecture	1601.3	Mid Term II End term
32, 33	Pole and essential singularity	Basic Knowledge of Poles	Lecture	1601.3	Mid Term II End term
34, 35	Residues; Residue theorem	Understanding of Residue Theorem	Lecture	1601.4	Mid Term II End term
36, 37	Real definite integrals: Evaluation using the calculus of residues	Understanding of Evaluation of specific Definite integrals	Lecture	1601.4	Mid Term II End term
38, 39	Integration on the unit circle.	Understanding of Evaluation of specific Definite integrals	Lecture	1601.4	Mid Term II End term
40, 41, 42	Transformations: Introduction	Basic Knowledge of Complex Transformations	Lecture	1601.5	Mid Term II End term
43, 44	Bilinear transformation	Understanding of specific Transformations	Lecture	1601.5	Mid Term II End term
45,46	Cross-ratio and Properties	Understanding of Properties of Transformations	Lecture	1601.5	End term
47,48	Inverse points	Understanding of Properties of Transformations	Lecture	1601.5	End term
49, 50	Elementary transformations e.g. the function	Understanding of Properties of Transformations	Lecture	1601.5	End term

G. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	**STATEMENT**	**CORRELATION WITH PROGRAM OUTCOME**							**CORRELATION WITH PROGRAM SPECIFIC OUTCOME**		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
MA 1601.1	Understand the importance and significance of differentiability for	1	2	1				1	2	2	2

	complex functions and be familiar with the Cauchy-Riemann equations										
MA 1601.2	Use the general Cauchy integral theorem to get parameterizations of curves, and compute line integrals.	2	3	0			1	2	1	1	1
MA 1601.3	Expand the function in terms of power series. Define singularities of a function, know the different types of singularities, and be able to determine the points of singularities of a function.	2	2	2				1	1	2	1
MA 1601.4	Use the residue theorem to compute several kinds of real integrals**.**	2	2	1				2	1	1	1
MA 1601.5	Construct conformal mappings and tansformations between many kinds of domain.	2	2	1				1	1	1	2

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics
Course Hand-out

Introduction to Special Functions and Integral Transforms | MA1602| 4 Credits | 3 1 0 4

Session: Jan – June 2021 | Faculty: Dr. Alok Bhargava | Class: B. Sc. (Hons) Mathematics VI Sem

A. Introduction: This course is offered by Dept. of Mathematics as a core subject, targeting students who wish to pursue research or higher studies in the field of fractional calculus, special functions, and geometric function theory. Students are expected to have knowledge of complex functions, analyticity, singularity, and integration for a better learning.

Course Objectives: At the end of the course, students will be able to

[1602.1] Describe the concept of special functions, Hypergeometric function and their properties which enhance their problem-solving skills.

[1602.2] Describe the concept of Bessel's function and Legendre Polynomial and their properties.

[1602.3] Describe the concept of Laplace Transform its properties and applications, which enhance their problem-solving skills and make them employable in the relevant field.

[1602.4] Describe the concept of Fourier Transform its properties and applications, which enhance their problem-solving skills and make them employable in the relevant field.

B. Program Outcomes and Program Specific Outcomes

PO1. **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2. **Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO.1 To understand the basic Mathematical & Statistical principles and to explain them clearly

PSO.2 To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 To develop creative thinking and the power of imagination.

PSO.4 To expose the graduates in research in academia and industry for broader applications

C. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Close Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

D. Syllabus

Special functions: Gauss hypergeometric function and its properties; Integral representation; Gauss theorem; Vandermonde's theorem; Kummer's theorem; Relation of contiguity; Confluent hypergeometric function; Integral representation; Kummer's relation; Bessel functions and their properties; Convergence; Recurrence relations; Generating functions, Orthogonality of Bessel functions; Legendre polynomials; Generating function; Orthogonal property of Legendre's polynomials; Recurrence relations; Rodrigue's formula. **Laplace transform:** Existence theorem for Laplace transform; Linearity of the Laplace transform; Shifting theorem; Laplace transforms of derivatives and integrals; Differentiation and integration of Laplace transform; Laplace transform of some special functions; Inverse Laplace transform; Convolution theorem; Inverse Laplace transforms of derivatives and integrals; Method of partial fraction; Solution of ordinary differential equations using Laplace transform. **Fourier transform:** Sine, cosine, and complex Fourier transform; Linearity property; Shifting; Fourier transform of derivatives; Relations between Fourier transform and Laplace transform; Inverse Fourier transform; Convolution theorem; Parseval's identity for Fourier transform.

E. Text Books

1. M. D. Raisinghania, Advanced Differential Equations, S. Chand & Comp., New Delhi, 2010.
2. B. Davies, Integral Transforms and Their Applications, 3rd Edition, Springer, 2002.

F. Reference Books:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 4th Edition, Narosa Publishing House, 2014.
2. G. Andrews, R. Askey & R. Roy, Special Functions, Cambridge, 1999.
3. L. Debnath and D. Bhatta, Integral Transforms and Their Applications, 2nd Edition, CRC Press, 2006.

G. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction to course		Lecture		
2	Laplace transform: Introduction, Existence theorem	Basic Knowledge of Integral Transforms, Laplace Transform	Lecture	1602.3	Mid Term 1 End term
3	Laplace Transform of some elementary functions	Basic Knowledge of Laplace Transform	Lecture	1602.3	Mid Term 1 End term
4 - 9	Properties of Laplace Transform	Basic Knowledge of properties of Laplace Transform	Lecture	1602.3	Mid Term 1 End term
10	Evaluation of Definite integrals, Laplace Transform of some special functions	Basic knowledge of application of Laplace Transform	Lecture	1602.3	Mid Term 1 End term
11	Inverse Laplace Transform, Lerch's Theorem	Basic Knowledge of Inverse Laplace Transform	Lecture	1602.3	Mid Term 1 End term
12,13,14	Properties of Inverse Laplace Transform	Basic Knowledge of properties of Inverse Laplace Transform	Lecture	1602.3	Mid Term 1 End term
15	Convolution Theorem	Basic Knowledge of properties of Inverse Laplace Transform	Lecture	1602.3	Mid Term 1 End term
16,17	Application of Laplace Transform to solve ODE and PDE	Application of Laplace Transform	Lecture	1602.3	Mid Term 1 End term
18,19	Fourier transform: Introduction, Sine and Cosine Transform	Basic Knowledge of Fourier Transform	Lecture	1602.4	Mid Term 2 End term
20,21	Properties of Fourier Transform	Basic Knowledge of properties of Fourier Transform	Lecture	1602.4	Mid Term 2 End term
22	Fourier Integral Theorem	Basic Knowledge of properties of Fourier Transform	Lecture	1602.4	Mid Term 2 End term

23,24	Inversion formulae for Fourier Transform	Basic Knowledge of properties of Inverse Laplace Transform	Lecture	1602.4	Mid Term 2 End term
25	Convolution Theorem, Relation between Laplace Transform and Fourier Transform	Knowledge of Relation between Laplace Transform and Fourier Transform	Lecture	1602.4	Mid Term 2 End term
26	Application of Fourier Transform to solve differential equations	Application of Fourier Transform	Lecture	1602.4	Mid Term 2 End term
27	Bessel functions	Basic Knowledge of Special function – Bessel's Function	Lecture	1602.2	Mid Term 2 End term
28	properties of Bessel functions	Understanding of Properties of Bessel function	Lecture	1602.2	Mid Term 2 End term
29	Convergence condition for Bessel functions	Understanding of Properties of Bessel function	Lecture	1602.2	Mid Term 2 End term
30,31	Recurrence relations of Bessel functions	Understanding of Properties of Bessel function	Lecture	1602.2	Mid Term 2 End term
32	Generating functions for Bessel functions	Understanding of Properties of Bessel function	Lecture	1602.2	Mid Term 2 End term
33	Orthogonality of Bessel functions	Understanding of Properties of Bessel function	Lecture	1602.2	Mid Term 2 End term
34	Legendre polynomials	Basic Knowledge of Legendre Polynomial	Lecture	1602.2	End term
35	Generating function	Understanding of Properties of Legendre Polynomial	Lecture	1602.2	End term
36	Orthogonal property of Legendre's polynomials	Understanding of Properties of Legendre Polynomial	Lecture	1602.2	End term
37,38	Recurrence relations of Legendre's polynomials	Understanding of Properties of Legendre Polynomial	Lecture	1602.2	End term
39	Rodrigue's formula of Legendre's polynomials	Understanding of Properties of Legendre Polynomial	Lecture	1602.2	End term
40	Gauss hypergeometric function	Basic Knowledge of Hypergeometric functions	Lecture	1602.1	End term
41,42	properties of Gauss hypergeometric function	Understanding of Properties of Gauss Hypergeometric function	Lecture	1602.1	End term
43	Integral representation of Gauss hypergeometric function	Understanding of Properties of Gauss Hypergeometric function	Lecture	1602.1	End term
44	Gauss theorem	Understanding of Properties of Gauss	Lecture	1602.1	End term

		Hypergeometric function			
45	Vandermonde's theorem	Understanding of Properties of Gauss Hypergeometric function	Lecture	CO 1	End term
46	Kummer's theorem, Relation of contiguity	Understanding of Properties of Gauss Hypergeometric function	Lecture	CO 1	End term
47	Confluent hypergeometric function	Understanding of Properties of Hypergeometric function	Lecture	CO 1	End term
48	Integral representation of Confluent hypergeometric function	Understanding of Properties of Hypergeometric function	Lecture	CO 1	End term
49	Kummer's relation	Understanding of Properties of Hypergeometric function	Lecture	CO 1	End term

H. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
1602.1	Describe the concept of special functions and their properties which enhance their problem-solving skills.	1						2						3	3		3
1602.2	Describe the concept of Hypergeometric function and its properties.	1						2						3	3		3
1602.3	Describe the concept of Laplace Transform its properties and applications, which enhance their problem-solving skills and make them employable in the relevant field.	1						2						3	3		3
1602.4	Describe the concept of Fourier Transform its properties and applications, which enhance their problem-solving skills and make them employable in the relevant field.	1						2						3	3		3

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

MANIPAL UNIVERSITY JAIPUR

School of Basic Science

Department of Mathematics & Statistics
Course Hand-out

Number Theory | MA 1651 | 4 Credits | 3 1 0 4

Session: January – May 2021 | Faculty: Dr. Rishikesh Dutta Tiwary | Class: B.Sc Mathematics (Hons) VI SEM

A. **Introduction:** This course is offered by Department of Mathematics and Statistics for B.Sc Mathematics (Hons.) students, targeting students who wish to pursue research & development in industries or higher studies in field of Mathematics and Engineering. Topics discussed include divisibility, the greatest common divisor and least common multiple, prime numbers and their properties, the unique factorization theorem, basic properties of congruences, linear congruences and linear Diophantine equations, the Chinese Remainder Theorem, applications of congruences, the theorems of Fermat, Euler and Wilson, arithmetic functions and their properties, quadratic congruences, quadratic residues and the Quadratic reciprocity law, and primitive roots. Students will able to apply some basic techniques of number theory for the representation of integers.

B. **Course Outcomes:** At the end of the course, students will be able to

[MA 1651.1] Describe the basic concepts of number theory, prime numbers and their uses which enhance their logical and analytical skills.

[MA 1651.2] Describe the concepts of number theoretic functions and their properties.

[MA 1651.3] Describe the concept of conjectures and their formation about the integers.

[MA 1651.4] Describe the concept of Diophantine equations & Fermat's equation, their simplification which sharpen the problem-solving skills and make them employable.

[MA 1651.5] Describe the concept of primitive roots and quadratic reciprocity law and properties.

[MA1651.6] Describe the concept of presentation of integers, Fibonacci numbers and properties.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

The PSO's of B.Sc. in Mathematics programme are:

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments, Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Introduction of number theory: Algebraic operations with integers; Well ordering principle and mathematical induction; Division algorithm; binary and decimal representation of integers; Lame's theorem. **Prime numbers:** Sieve of Eratosthenes; Fundamental theorem of arithmetic; Linear Diophantine equation; Prime counting function; Statement of prime number theorem; Goldbach conjecture.

Congruence: Linear congruence; Complete set of residues; Chinese remainder theorem; Polynomial congruence; Fermat's little theorem; Fermat-Kraitchik factorization method; Pseudo primes; Wilson's theorem; Euler's theorem. **Number theoretic functions:** Sum and number of divisors functions; Totally multiplicative functions; The Möbius inversion formula; The greatest integer function; Euler's phi-function; Reduced set of residues; Some properties of Euler's phi-function; Definition and properties of the Dirichlet product.

Primitive roots and quadratic residues: Order of an integer modulo n; Primitive roots for primes; Composite numbers having primitive roots; Theory of indices. **The quadratic reciprocity law:** Euler's criterion; The Legendre symbol and its properties; Quadratic reciprocity; Quadratic congruence with composite moduli; Jacobi symbol and its properties.

Numbers of special forms: Perfect numbers; Mersenne primes; Amicable numbers; Fermat numbers. **Certain nonlinear Diophantine equations:** The equation $x^2 + y^2 = z^2$; Fermat's last theorem.

Representation of integers: Sums of two squares; Sums of more than two squares. **Fibonacci numbers:** The Fibonacci sequence; Certain identities involving Fibonacci numbers.

F. REFERENCE BOOKS

1. S. Telang, M. Nadkarni and J. Dani, Numer Theory, McGraw-Hill Edition, Indian reprint, 2004.
2. D. M. Burton, Elementary Number Theory, 6th Edition, Tata McGraw-Hill Edition, Indian reprint, 2007.
3. I. Niven, H. S. Zuckerman and H. L. Montgomery, An Introduction to the Theory of Numbers, 5th Edition, Wiley-India, 2009.
4. T. Koshy, Elementary Number Theory with Applications, Elsevier India Pvt Ltd, 2005.
5. N. Robbins, Beginning Number Theory, 2nd Edition, Narosa Publishing House, Delhi, 2007.
6. A. K. Chaudhary, An Introduction to Number Theory, New Central Book Agency, Kolkata, 2009.

1.

G. Lecture Plan:

Lecture No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction and Course Hand-out briefing	To acquaint and clear teachers' expectations and understand student expectations	Lecture Interaction	--	N/A
2	Algebraic operations with integers; Division algorithm	the fundamental operations on integers	Lecture	1651.1	Class Quiz Home Assignment
3	Well ordering principle and mathematical induction	Construct mathematical proofs of statements	Lecture	1651.1	Class Quiz Home Assignment
4	Binary and decimal representation of integers	Concept of binary digits and its applications	Lecture	1651.1	Class Quiz Home Assignment
5	Lame's theorem	Application of Fibonacci number	Lecture	1651.1, 1651.5	Class Quiz Home Assignment
6	Problem solving	Problem solving technique	Tutorial	1651.1, 1651.5	Class Quiz Home Assignment
7	**Prime numbers:**	To explore various important classes of positive integers	Lecture	1651.2	Class Quiz Home Assignment
8	Fundamental theorem of arithmetic	To know how to factorize any positive integer	Lecture	1651.2	Class Quiz Home Assignment
9	Prime counting function	To explore various important classes of positive integers	Lecture	1651.2	Class Quiz Home Assignment

10	Statement of prime number theorem	To explore various important classes of positive integers	Lecture	1651.2	Class Quiz Home Assignment
11	Sieve of Eratosthenes, Goldbach conjecture	To explore various important classes of positive integers	Lecture	1651.1, 1651.2	Class Quiz Home Assignment
12	Problem solving	Problem solving technique	Tutorial	1651.1, 1651.2	Class Quiz Home Assignment
13	Linear congruence	Familiar with congruence	Lecture	1651.2	Class Quiz Home Assignment
14	Complete set of residues	Deals with problems of residue	Lecture	1651.2	Class Quiz Home Assignment
15	Chinese remainder theorem	Understand the basic theorem and its application	Lecture	1651.2, 1651.5	Class Quiz Home Assignment
16	Polynomial congruence	Deals with problems of residue	Lecture	1651.2	Class Quiz Home Assignment
17	Fermat's little theorem; Fermat-Kraitchik factorization method	Concept of theorems and its uses	Lecture	1651.2, 1651.5	Class Quiz Home Assignment
18	Pseudo primes	Concept of theorems and its uses	Lecture	1651.2	Class Quiz Home Assignment
19	Wilson's theorem	Concept of theorems and its uses	Lecture	1651.2	Class Quiz Home Assignment
20	Euler's theorem	Concept of theorems and its uses	Lecture	1651.2	Class Quiz Home Assignment
21	Problem Solving	Concept of theorems and its uses	Tutorial	1651.1, 1651.2, 1651.5	Class Quiz Home Assignment
FIRST SESSIONAL EXAM					
22	**Number theoretic functions**	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
23	Sum and number of divisors functions	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
24	Totally multiplicative functions	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
25	The Möbius inversion formula	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
26	The greatest integer function	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment

27	Euler's phi-function	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
28	Reduced set of residues	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
29	Some properties of Euler's phi-function	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
30	Definition and properties of the Dirichlet product	To know about multiplicative functions and their properties	Lecture	1651.3	Class Quiz Home Assignment
31	Problem Solving	To know about multiplicative functions and their properties	Tutorial	1651.3	Class Quiz Home Assignment
32	**Primitive roots and quadratic residues**	To learn quadratic residues	Lecture	1651.3	Class Quiz Home Assignment
33	Order of an integer modulo n	To learn quadratic residues	Lecture	1651.3	Class Quiz Home Assignment
34	Primitive roots for primes	To discuss the order of an integer and primitive roots	Lecture	1651.3	Class Quiz Home Assignment
35	Composite numbers having primitive roots	To discuss the order of an integer and primitive roots	Lecture	1651.3	Class Quiz Home Assignment
36	Theory of indices	To discuss the order of an integer and primitive roots	Lecture	1651.3	Class Quiz Home Assignment
37	Problem Solving	Problem solving technique	Tutorial	1651.3	Class Quiz Home Assignment
38	**The quadratic reciprocity law**	Understand the law of quadratic reciprocity	Lecture	1651.3, 1651.4, 1651.5	Class Quiz Home Assignment
39	Euler's criterion	Understand the law of quadratic reciprocity	Lecture	1651.4, 1651.5	Class Quiz Home Assignment
40	The Legendre symbol and its properties	Understand the law of quadratic reciprocity	Lecture	1651.4	Class Quiz Home Assignment
41	Quadratic reciprocity	Understand the law of quadratic reciprocity	Lecture	1651.4	Class Quiz Home Assignment
42	Quadratic congruence with composite moduli	Understand the law of quadratic reciprocity	Lecture	1651.4, 1651.5	Class Quiz Home Assignment
43	Jacobi symbol and its properties	Understand the law of quadratic reciprocity	Lecture	1651.4, 1651.5	Class Quiz Home Assignment
SECOND SESSIONAL EXAM					

44	**Numbers of special forms:** Perfect numbers; Mersenne primes	Concept of special number	Lecture	1651.1, 1651.4	Class Quiz Home Assignment
45	Amicable numbers; Fermat numbers	Concept of special number	Lecture	1651.3, 1651.4	Class Quiz Home Assignment
46	Problem Solving	Techniques for solving problems	Discussion	1651.3, 1651.4, 1651.5	Class Quiz Home Assignment
47	**Certain nonlinear Diophantine equations:** The equation $x^2 + y^2 = z^2$	Solve the Equations	Lecture	1651.4	Class Quiz Home Assignment
48	Fermat's last theorem.	Solve the Equations	Lecture	1651.4, 1651.5	Class Quiz Home Assignment
49	**Representation of integers:** Sums of two squares; Sums of more than two squares	Formations of different sequences and its properties	Lecture	1651.4	Class Quiz Home Assignment
50	**Fibonacci numbers:** The Fibonacci sequence	Formations of different sequences and its properties	Lecture	1651.4	Class Quiz Home Assignment
51	Certain identities involving Fibonacci numbers	Formations of different sequences and its properties	Lecture	1651.4	Class Quiz Home Assignment
52	Final Review	Formations of different sequences and its properties	Group Discussion	1651.1, 1651.2, 1651.3, 1651.4, 1651.5	Class Quiz Home Assignment
End Term Exam					

H. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes **(POs)**							Correlation with Program Specific Outcomes (**PSOs**)			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
[MA1651.1]	Describe the basic concepts of number theory, prime numbers and their uses which enhance their logical and analytical skills.	**2**						**2**		**2**	**3**	**3**
[MA1651.2]	Describe the concepts of number theoretic functions and their properties.	**2**						**2**	**2**			
[MA1651.3]	Describe the concept of conjectures and their formation about the integers.	**2**						**2**			**1**	
[MA1651.4]	Describe the concept of Diophantine equations & Fermat's equation, their simplification which sharpen the problem-solving skills.	**2**						**2**	**1**	**1**		**2**
[MA1651.5]	Describe the concept of primitive roots and quadratic reciprocity law and properties.	**2**						**2**	**1**	**3**	**3**	**3**
[MA1651.6]	Describe the concept of presentation of integers, Fibonacci numbers and properties.	**2**						**2**				

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics and Statistics
Course Hand-out

Design of Experiments| MS 1605 | 3 Credits | 2 1 0 3

Session: Jan. 21 – May 21 | Faculty: **Dr. Ashish Kumar** | Class: B.Sc. (Hons.) /B.A.(Hons.) VI Sem

A. **Introduction:** This course is offered by Dept. of Mathematics and Statistics, which deals with the concepts and techniques used of analysis of variance, design of experiments and factorial experiments. At the same time it provides an indication of the relevance and importance of the theory in solving real life problems with the knowledge of statistical software SPSS.

B. **Course Outcomes:** Upon successful completion of this course, the students should have the Knowledge and skills to demonstrate a high level of understanding and be able to communicate the following topics:

[MS1605.1] Understand the theory, concepts and issues of analysis of variance to solve the real life Problems.
[MS1605.2] Understand the theory, concepts and issues of Design of Experiments to solve the real life problems.
[MS1605.3] Understand the theory, concepts and issues of Factorial Experiments to solve the real life Problems.
[MS1605.4] Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.

C. **PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Closed Book)	20
	Sessional Exam II (Closed Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Analysis of Variance: Meaning - Models and Analysis of Variance, Contrasts and Analysis of Variance, Orthogonal contrasts. Assumptions, Analysis of Variance for one- way, two -way with one/m observations per cell for fixed, mixed and random effects models, Tukey's test for non-additivity. **Design of Experiment:** Meaning and need of design of experiments, Terminology, Experimental Error, Choice of size, Shape of plots and blocks. Basic principles of experimental design- replication, randomization and local control, Different Experimental designs- Completely Randomized Design(CRD), Randomized Block Design(RBD) and Latin Square Design(LSD). Missing plot techniques – layout, model, statistical analysis, advantages and disadvantages, efficiency, missing plot techniques. **Factorial Experiments:** Concept, Notations of factorial experiments. 2^2-experiments and 2^3-experiments- Yates method of computing factorial effects total. Confounding- partial confounding in 2^3-experiments.

F. TEXT BOOKS

1. Das, M.N. and Giri, N.C., Design and Analysis of Experiments, Wiley Eastern Ltd, 1986.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B., Fundamentals of Statistics. Vol. II, 8th Edition. World Press, Kolkata, 2005.
3. Gupta, S.C. and Kapoor, V.K: Fundamentals of Applied statistics, Sultan Chand and Co., 3rd edition, New Delhi, 2008.

G. REFERENCE BOOKS

1. Cochran, W.G. and Cox, G.M., Experimental Design, Asis Publishing House, 1959.
2. Kempthorne, O., The Design and Analysis of Experiments, John Wiley, 1965.
3. Montgomery, D. C., Design and Analysis of Experiments, John Wiley, 2008.
4. Aloke Dey, Theory of Block Design, J. Wiley, 1986.

H. Lecture Plan:

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1,2	Analysis of Variance: Concept, assumptions and basics of ANOVA	illustrate the concept of testing of more than two samples	Lecture	MS1605.1	Home Assignment Class Quiz Mid Term I End Term
3,4	Construction of contrasts , orthogonal contrasts	Understand the concept of contrast	Lecture	MS1605.1	Home Assignment Class Quiz Mid Term I End Term
5,6	Layout and model of one way ANOVA	Framework of one-way ANOVA	Lecture	MS1605.1	In Class Quiz Mid Term I End Term
7,8,9	Analysis of one way ANOVA with examples	Framework of one-way ANOVA	Lecture	MS1605.1	Home Assignment Mid Term I End Term
10, 11	Layout of two way ANOVA with one observation per cell	Describe the conceptual framework of two way ANOVA	Lecture	MS1605.1	In Class Quiz Mid Term I End Term
12,13,14	Model and analysis of two way ANOVA with one observation per cell with examples	Understand two-way ANOVA	Lecture	MS1605.1	Class Quiz Mid Term I End Term
15,16	Tukey's test of non-additivity	Describe properties of Posthoc test	Lecture	MS1605.1	Class Quiz Mid Term I End term

17,18,19, 20	Layout of two way ANOVA with m observation per cell	Understand the framework of m-variables	Lecture	MS1605.4	Home Assignment Class Quiz Mid Term I End Term
21,22	Meaning and need of design of experiments, Terminology, Experimental Error, Choice of size, Shape of plots and blocks. Basic principles of experimental design-replication, randomization and local control	Understand concepts of design for research	Lecture	MS1605.2	Class Quiz Mid Term II End Term
23,24	Different Experimental designs- Completely Randomized Design(CRD)-layout, model, statistical analysis, advantages and disadvantages	Understand concepts of CRD	Lecture	MS1605.2	Class Quiz Mid Term II End Term
25,26,27	Randomized Block Design(RBD)-layout, model, statistical analysis, advantages and disadvantages	Understand concepts of RBD	Lecture	MS1605.2	Class Quiz Mid Term II End Term
28,29	Latin Square Design(LSD)-layout, model,	Understand the concept of LSD	Lecture	MS1605.2	Class Quiz Mid Term II End Term

	statistical analysis, advantages				
30,31	missing plot techniques in RBD	Understand importance of missing plot	Lecture, Activity	MS1605.2	Class Quiz Mid Term II End Term
32	Efficiency LSD over CRD, efficiency of LSD over RBD.	Understand relationship between LSD, RBD, CRD	Lecture, Activity	MS1605.4	Class Quiz Mid Term II End Term
33	**Factorial Experiments:** Concept, Notations of factorial experiments.	Understand concept of factorial experiments	Lecture	MS1605.3	Class Quiz End Term
34	2^2-experiments Yates method of computing factorial effects total.	Can handle Yates factorial effects	Lecture	MS1605.3	Class Quiz End Term
35	2^3-experiments.	Framework of 2^3 *experiments*	Lecture	MS1605.3	Class Quiz End Term
36	Confounding- partial confounding in 2^3-experiments.	Familiarity with confounding	Lecture	MS1605.4	Class Quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1605.1	Understand the theory, concepts and issues of analysis of variance to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.	3	2		1	3	2	1				
MS1605.2	Understand the theory, concepts and issues of Design of Experiments to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.	1		3		2		2				
MS1605.3	Understand the theory, concepts and issues of Factorial Experiments to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.	1		3		2	3					
MS1605.4	Distinguish business strategies by taking account of data analysis techniques	1		2		2		3				

	for consultancy and employment ability.											

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%							ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1605.1	Understand the theory, concepts and issues of analysis of variance to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.											
MS1605.2	Understand the theory, concepts and issues of Design of Experiments to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.											
MS1605.3	Understand the theory, concepts and issues of Factorial Experiments to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical											

	software SPSS.											
MS1605.4	Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.											

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

STOCHASTIC PROCESSES | MS1606| 4 Credits | 3 1 0 4

Session: Jan. – May, 2021 | Faculty: **Dr. Mohammad Rizwanullah** | Class: B.Sc. /B.A. VI Sem.

A. Introduction:-

Stochastic models are among the most widely used tools in operations research and management science. Stochastic processes and applications can be used to analyse and solve a diverse range of problems arising in production & inventory control, resource planning, service systems, computer networks and many others. This course, with an emphasis on model building, covers, Markov chains, Poisson processes and queuing theory.

B. Course Outcomes: At the end of the course, students will be able to

1606.1	Understand the conceptual framework of Probability generating functions
1606.2	Understand conceptual framework of Stochastic Process
1606.3	Understand conceptual framework of Markov Chains
1606.4	Understand conceptual framework of Continuous time Markov Chain
1606.5	Develop a conceptual framework to apply these techniques in industry that help in employability

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1].Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
[PO2].Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
[PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes

PSO.1	to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Closed Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS:-

Probability Generating Functions: Introduction, probability generating function: mean and variance, sum of random variables, stochastic sum, generating function of bivariate distribution, Laplace transforms and its properties, Laplace transform of a probability distribution or of a random variable, mean and variance in terms of Laplace transform, three important theorems, randomization and mixtures and classification of distributions. **Stochastic Processes:** Introduction, definition and examples of stochastic process, classification of general stochastic processes into discrete/continuous time, discrete/continuous state spaces, types of stochastic processes elementary problems, random walk, gambler's ruin problem. **Markov chains:** Definition and examples of Markov chain, transition probability matrix, classification of states, recurrence, simple problems, basic limit theorem of Markov chain, stationary probability distribution, applications. **Continuous time Markov Chain:** Poisson process and related inter-arrival time distribution, pure birth process, pure death process, birth and death process, problems.

F. TEXT BOOKS:-

1. Medi J., Stochastic Processes, New Age International Publication, 2009.

2. Ross S.M., Stochastic Process, John Wiley, 1983.

G. REFERENCE BOOKS:-

1. Karlin S. and Taylor H.M., A First Course in Stochastic Process, Academic Press, 1995.

2. Parzen E., Stochastic Process, Holden-Day, 1962.

3. Cinlar E., Introduction to Stochastic Processes, Prentice Hall, 1975.

4. Taylor H.M. and Karlin S., Stochastic Modeling, Academic Press, 1999.

5. Hari Singh Parihar and Ritu Agarwal, Statistics & Probability Theory, NK Publication.

H. Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
2	**2**	**Probability Generating Functions:** Introduction, probability generating function: mean and variance, sum of random variables, stochastic sum,
3	**5**	generating function of bivariate distribution
3	**8**	Laplace transforms and its properties,
4	**12**	Laplace transform of a probability distribution or of a random variable, mean and variance in terms of Laplace transform,
3	**15**	three important theorems,
3	**18**	randomization and mixtures and classification of distributions.
2	**20**	**Stochastic Processes:** Introduction, definition and examples of stochastic process,
3	**23**	classification of general stochastic processes into discrete/continuous time, discrete/continuous state spaces
4	**27**	types of stochastic processes elementary problems,
3	**30**	random walk, gambler's ruin problem
3	**33**	**Markov chains:** Definition and examples of Markov chain, transition probability matrix, classification of states, recurrence, simple problems
4	**37**	basic limit theorem of Markov chain, stationary probability distribution, applications.
3	**40**	**Continuous time Markov Chain:** Poisson process and related inter-arrival time distribution

4	**44**	pure birth process, pure death process
4	**48**	birth and death process, problems.

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1606.1	Understand the conceptual framework of Probability generating functions	**2**			**2**			**3**				
MS1606.2	Understand conceptual framework of Stochastic Process		**2**	**3**		**2**						
MS1606.3	Understand conceptual framework of Markov Chains	2		**3**			**1**					
MS1606.4	Understand conceptual framework of Continuous time Markov Chain		**3**		**2**			**3**				
MS1606.5	Develop a conceptual framework to apply these techniques in industry that help in employability	**2**	**3**		**3**	**1**		**3**				

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

J. Course Outcome Attainment Level Matrix:-

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%							ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O 1	PS O 2	PS O 3	PS O 4
MS1606.1	Understand the conceptual framework of Probability generating functions											
MS1606.2	Understand conceptual framework of Stochastic Process											

MS1606.3	Understand conceptual framework of Markov Chains											
MS1606.4	Understand conceptual framework of Continuous time Markov Chain											
MS1606.5	Develop a conceptual framework to apply these techniques in industry that help in employability											

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY
JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand – Out

Lab on Design of Experiment| MS1631 | 1 Credits | 0 0 2 1

Session: Jan. 2021– May 2021 | Faculty: Dr. Ashish Kumar | Class: B.Sc. /B.A. VI Sem.

A. Introduction:-

The use of statistical reasoning and methodology is indispensable in modern world. It is applicable to every discipline, be it physical sciences, engineering and technology, economics or social sciences. Much of the advanced research in electronics, electrical, computer science, industrial engineering, biology, genetics, and information science relies increasingly on use of statistical tools. It is essential for the students to get acquainted with the subject of probability and statistics at an early stage. The present course has been designed to introduce the subject to undergraduate/postgraduate students in science and engineering. The course contains a good introduction to each topic and an advance treatment of theory at a fairly understandable level to the students at this stage. Each concept has been explained through examples and application oriented problems.

B. Course Outcomes: At the end of the course, students will be able to

1631.1 Understand the theory, concepts and issues of analysis of variance to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical Software SPSS.

1631.2 Understand the theory, concepts and issues of Design of Experiments to solve the real Life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.

1631.3 Understand the theory, concepts and issues of Factorial Experiments to solve the real Life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.

1631.4 Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO.1 to teach a wide range of Mathematics & Statistics at a basic level and stimulate the interest of students in Mathematics & Statistics

PO.2 producing graduates who are well grounded in the fundamentals of Mathematics & Statistics and acquisition of the necessary skills, in order to use their knowledge in Mathematics & Statistics in a wide range of practical application.

PO.3 To acquire discipline – based skills in pure Mathematics, applied Mathematics, Mathematical Statistics and Operations research.

PO.4 To analyse situations, search for truth and extract information, formulate and solve problems in a systematic and logical manner.

PO.5 Graduates of the program will continue to learn and to adapt in a world of constantly evolving and innovative technology

PO.6 Function on multidisciplinary teams by working cooperatively, creatively and responsibly as a member of a team

PO.7 Pursue for Master's program in Mathematics, Statistics and Operations Research.

PSO.1 to understand the basic Mathematical & Statistical principles and to explain them clearly.

PSO.2 to apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics

PSO.3 to develop creative thinking and the power of imagination.

PSO.4 to expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:-

Criteria	Description	Maximum Marks
Lab	Practical Lab Exam	40
	Day to Day Assessment	60
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity will be assessed and marks will be awarded.	

E. SYLLABUS:-

Analysis of Variance: Meaning - Models and Analysis of Variance, Contrasts and Analysis of Variance, Orthogonal contrasts. Assumptions, Analysis of Variance for one- way, two -way with one/m observations per cell for fixed, mixed and random effects models, Tukey's test for non-additivity. **Design of Experiment:** Meaning and need of design of experiments, Terminology, Experimental Error, Choice of size, Shape of plots and blocks. Basic principles of experimental design- replication, randomization and local control, Different Experimental designs- Completely Randomized Design(CRD), Randomized Block Design(RBD) and Latin Square Design(LSD). Missing plot techniques – layout, model, statistical analysis, advantages and disadvantages, efficiency, missing plot techniques. **Factorial Experiments:** Concept, Notations of factorial experiments. 2^2-experiments and 2^3-experiments- Yates method of computing factorial effects total. Confounding- partial confounding in 2^3-experiments.

F. TEXT BOOKS

1. Das, M.N. and Giri, N.C., Design and Analysis of Experiments, Wiley Eastern Ltd, 1986.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B., Fundamentals of Statistics. Vol. II, 8th Edition. World Press, Kolkata, 2005.
3. Gupta, S.C. and Kapoor, V.K: Fundamentals of Applied statistics, Sultan Chand and Co., 3rd edition, New Delhi, 2008.

G. REFERENCE BOOKS

1. Cochran, W.G. and Cox, G.M., Experimental Design, Asis Publishing House, 1959.
2. Kempthorne, O., The Design and Analysis of Experiments, John Wiley, 1965.
3. Montgomery, D. C., Design and Analysis of Experiments, John Wiley, 2008.
4. Aloke Dey, Theory of Block Design, J. Wiley, 1986.

H. Lecture Plan:-

S No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode Of Assessing CO
1	Program on One way ANOVA	Framework of one-way ANOVA	Demonstration	1631.1	Quiz I, Viva voce & End Term
2	Program on Two way ANOVA one observation per cell	Describe the conceptual framework of two way ANOVA	Demonstration	1631.1	Quiz I, Viva voce & End Term
3	Program on Two way ANOVA m observations per cell	Describe the conceptual framework of two way ANOVA	Demonstration	1631.2	Quiz I, Viva voce & End Term
4	Program on completely randomized design	Understand concepts of CRD	Demonstration	1631.2	Quiz I, Viva voce & End Term
5	Program on randomized blocked design	Understand concepts of RBD	Demonstration	1631.3	Quiz II, Viva voce & End Term
6	Program on latin square design	Understand the concept of LSD	Demonstration	1631.3	QuizII, Viva voce & End Term

7	Program on Factorial experiments	Understand concept of factorial experiments	Demonstration	1631.3	Quiz II, Viva voce & End Term
8	End Term Exam				

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MS1631.1	Understand the theory, concepts and issues of analysis of variance to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.	**3**	**2**		**1**	**3**	**2**	**1**				
MS1631.2	Understand the theory, concepts and issues of Design of Experiments to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.	**1**		**3**		**2**		**2**				
MS1631.3	Understand the theory, concepts and issues of Factorial Experiments to solve the real life problems and give the conclusion in meaningful way with the utilization of statistical software SPSS.	1		**3**		**2**	**3**					
1631.4	Distinguish business strategies by taking account of data analysis techniques for consultancy and employment ability.	1		**2**		**2**		**3**				

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Physics

Course Hand-out

Atomic and Molecular Spectroscopy| PY 1611 | 3 Credits | 2 1 0 3

Session: JAN 20 – MAY 20 | Faculty: Dr. Anupam Sharma | Class: B.Sc. VI Sem.

A. Introduction: This course is offered by the Dept. of Physics as a core course, targeting students to pursue higher studies in the field of Basic Sciences. This course provides an introductory idea about the atoms in the form of isolated system composed of electrons and atomic nucleus. This course deals with the distribution of electrons around the nucleus and the processes that changes this arrangement. It also gives insightful knowledge about the changes in the spectra of different atoms in presence of an external field as well as the change in the energy levels of these atoms due to the different types of magnetic interactions. The present contents of this course also provide the basic physical properties like different types of spectra (electronic, rotational and vibrational) of different molecules composed of different atoms. This course also offers the basic understanding of Laser in spectroscopy.

B. Course Outcomes: At the end of the course, students will be able to

[PY 1611.1] interpret fundamental laws of atomic spectra.
[PY 1611.2] analyse the effect of external magnetic field on energy levels along with specific examples.
[PY 1611.3] discuss the various types of X-ray spectra.
[PY 1611.4] explain rotational, vibrational and electronic spectra of molecules.
[PY 1611.5] classify the complimentary character of Raman and infra-red spectra.
[PY 1611.6] utilize the various spectroscopic methods in practical applications which will enhance their skills and employability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO6. **Environment and Sustainability**: Understand the issues of environmental contexts and sustainable development.
PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1] To understand the basic Mathematical & Statistical principles and to explain them clearly.
[PSO2] To apply these principles both in simple exercises and in more complex problems of advanced Mathematics & Statistics
[PSO.3] To develop creative thinking and the power of imagination.
[PSO.4] To expose the graduates in research in academia and industry for broader applications

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20
	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam (Summative)	End Term Exam (Close Book)	50
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	Students who misses a class will have to report to the teacher about the absence. A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.	
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especially before a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Atomic spectra: Spectra of Hydrogen and Deuterium, Isotope effect and deduction of electron to proton mass ratio, L-S coupling, Spectral teems arising from L-S coupling, Doublet fine structure of hydrogen lines; Spectra of alkali atoms , screening constants for alkali spectra for s, p, d and f states, series limits, doublet structure of alkali spectrum, spectra of helium atom, singlet and triplet series, selection rules.

Magnetic field effect: Effect on energy levels; Gyromagnetic ratios for orbital and spin moments; Lande g factor, strong and weak field effects, illustrative cases of H, Na, and Hg, J-J couplings,

X- ray spectra: continuous X-ray spectrum , Duane and Hunt's law, Characteristics X rays, Moseley's law, doublet structure of X-ray spectra, X-ray absorption spectra.

Molecular Spectra: Electronic levels and quantum numbers for electronic states of diatomic molecules: singlet and triplet characters. Rational energy levels, inter nuclear distance, Vibration energy levels, force constants, isotope effect on rotational and vibration energies. Spectra of diatomic molecules: Pure rotation spectra: selection rules. Vibration rotation spectra: selection rules, P, Q, and R branches, Electronic band system, sequences and progressions.

Raman effect: Stokes and anti-Stokes lines, complimentary character of Raman and infrared spectra.

Emission/Absorption spectroscopy: sources, prism, grating and crystal spectrographs, Prism material useful for UV, V and IR regions, constant deviation systems. Concave grating, mountings, monochromators, resolution and dispersion in various spectrographs; sources for absorption studies in X-ray, UV, V and IR region, single-beam and double-bean instrument, detection systems , Lasers in spectroscopy.

F. TEXT BOOKS

T1. Raj Kumar, Atomic and Molecular spectra: Laser, Kedarnath-Ramnath, Delhi (2012).

T2. Kakkar Rita, Atomic and Molecular Spectroscopy: Basic concepts, Cambridge University Press (2015).

G. REFERENCE BOOKS

R1. Beiser A, Mahajan S and Rai Choudhary S, Concepts of Modern Physics, Tata McGraw Hill, Indian Edition (2009).

R2. Banwell Colin N and McCash Elaine M, Fundamentals of Molecular Spectroscopy, McGraw Hill Education (India) Pvt. Ltd. (2016).

R3. Arulhas G, Molecular Structure and Spectroscopy, PHI Learning Pvt. Ltd. (2007).

R4. Herzberg G, Atomic Spectra and Atomic Structure, Dover Publications (2008).

H. Lecture Plan:

LEC NO	TOPICS	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1	Discussion of lecture plan	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
2	Spectra of Hydrogen and Deuterium	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
3	Isotope effect and deduction of electron to proton mass ratio	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
4	L-S coupling, Spectral teems arising from L-S coupling	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
5	Doublet fine structure of hydrogen lines	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
6	Spectra of alkali atoms , screening constants for alkali spectra for s, p, d and f states	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
7	series limits, doublet structure of alkali spectrum	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
8	spectra of helium atom	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
9	singlet and triplet series, selection rules	understand fundamental laws of atomic spectra.	Lecture	**PY 1611.1**	MTE 1 ETE
10	**Tutorial – I (Numerical Problems)**	understand fundamental laws of atomic spectra.	Tutorial	**PY 1611.2**	MTE 1 ETE
11	Effect of magnetic field on energy levels	**a**nalyse the effect of external magnetic field on energy levels along with specific examples.	Lecture	**PY 1611.2**	MTE 1 ETE
12	Gyromagnetic ratios for orbital and spin moments	**a**nalyse the effect of external magnetic field on energy levels along with specific examples.	Lecture	**PY 1611.2**	MTE 1 ETE
13	Lande g factor	**a**nalyse the effect of external magnetic field on energy levels along with specific examples.	Lecture	**PY 1611.2**	MTE 1 ETE
14	strong and weak field effects	**a**nalyse the effect of external magnetic field on energy levels along with specific examples.	Lecture	**PY 1611.2**	MTE 1 ETE
15	Illustrative cases of H, Na, and Hg, J-J couplings,	**a**nalyse the effect of external magnetic field on energy levels along with specific examples.	Lecture	**PY 1611.2**	MTE 1 ETE
16	continuous X-ray spectrum	discuss the various types of X-ray spectra.	Lecture	**PY 1611.3**	MTE 1 ETE
17	Duane and Hunt’s law	discuss the various types of X-ray spectra.	Lecture	**PY 1611.3**	MTE 1 ETE

18	Characteristics X rays	discuss the various types of X-ray spectra.	Lecture	**PY 1611.3**	MTE 1 ETE
19	Moseley's law	discuss the various types of X-ray spectra.	Lecture	**PY 1611.3**	MTE 1 ETE
20	doublet structure of X-ray spectra	discuss the various types of X-ray spectra.	Lecture	**PY 1611.3**	MTE 1 ETE
21	X-ray absorption spectra	discuss the various types of X-ray spectra.	Lecture	**PY 1611.3**	MTE 1 Assignments ETE
22	**Tutorial – II (Numerical Problems)**	discuss the various types of X-ray spectra.	Tutorial	**PY 1611.3**	MTE 1 Assignments ETE
23	Electronic levels and quantum numbers for electronic states of diatomic molecules	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
24	singlet and triplet characters	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
25	Rational energy levels, inter nuclear distance	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
26	Vibration energy levels, force constants	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
27	Isotope effect on rotational and vibration energies	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
28	Spectra of diatomic molecules	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
29	Pure rotation spectra: selection rules. Vibration rotation spectra	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
30	selection rules, P, Q, and R branches	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
31	Electronic band system, sequences and progressions	explain rotational, vibrational and electronic spectra of molecules.	Lecture	**PY 1611.4**	MTE 2 ETE
32	**Tutorial – III (Numerical Problems)**	explain rotational, vibrational and electronic spectra of molecules.	Tutorial	**PY 1611.4**	MTE 2 ETE
33	Stokes and anti-Stokes lines	analyse the complimentary character of Raman and infra-red spectra.	Lecture	**PY 1611.5**	MTE 2 Assignment ETE
34	complimentary character of Raman and infrared spectra	analyse the complimentary character of Raman and infra-red spectra.	Lecture	**PY 1611.5**	MTE 2 Assignment ETE

35	sources, prism, grating and crystal spectrographs, Prism material useful for UV V and IR regions	**i**nspect the various spectroscopic methods used to study atoms and molecules which will enhance their skills and employability.	Lecture	**PY 1611.6**	ETE
36	Constant deviation systems. Concave grating, mountings, monochromators	**i**nspect the various spectroscopic methods used to study atoms and molecules which will enhance their skills and employability.	Lecture	**PY 1611.6**	ETE
37	Resolution and dispersion in various spectrographs	**i**nspect the various spectroscopic methods used to study atoms and molecules which will enhance their skills and employability.	Lecture	**PY 1611.6**	ETE
38	Sources for absorption studies in X-ray, UV, V and IR region, single-beam and double-bean instrument,	**i**nspect the various spectroscopic methods used to study atoms and molecules which will enhance their skills and employability.	Lecture	**PY 1611.6**	ETE
39	Detection systems , Lasers in spectroscopy	**i**nspect the various spectroscopic methods used to study atoms and molecules which will enhance their skills and employability.	Lecture	**PY 1611.6**	ETE
40	**Tutorial – IV (Numerical Problems)**	**i**nspect the various spectroscopic methods used to study atoms and molecules which will enhance their skills and employability.	Tutorial	**PY 1611.6**	ETE

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
PY 1611.1	interpret fundamental laws of atomic spectra.	3	1		1				1			
PY 1611.2	analyse the effect of external magnetic field on energy levels along with specific examples.	2	1					2		2	2	2
PY 1611.3	discuss the various types of X-ray spectra.	2	3		1			1			2	
PY 1611.4	explain rotational, vibrational and electronic spectra of molecules.	3						2	1			
PY 1611.5	classify the complimentary character of Raman and infra-red spectra.	2			1		2		1			
PY 1611.6	utilize the various spectroscopic methods in practical applications which will enhance their skills and employability.	2	1					2		2	2	2

1- **Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

MANIPAL UNIVERSITY JAIPUR
School of Basic Sciences

Department of Physics
Course Hand-out

Nuclear Physics| PY 1612 | 3 Credits | 2 1 0 3

Session: Jan, 21 – May, 21 | Faculty: Dr. Sushil Kumar Jain | Class: B.Sc. VI Sem.

A. Introduction: Nuclear physics is the study of the protons and neutrons at the centre of an atom and the interactions that hold them together in a space just a few femtometres (10^{-15} metres) across. The most commonly known applications of nuclear physics are nuclear power generation, but the modern nuclear physics contains also particle physics, which is taught in close association with nuclear physics. The nuclear physics has provided application in many fields, including those in nuclear medicine (Positron Emission Tomography, isotopes production, etc.) and magnetic resonance imaging, ion implantation in materials engineering, and radiocarbon dating in geology and archaeology. In this course we will learn basic properties of nucleus, subatomic particles, particle accelerators, detectors, and concept of fusion and fission

.

B. Course Objectives: At the end of the course, students will be able to

[PY 1612.1] describe the nuclear properties and models of nuclear physics.
[PY 1612.2] calculate the binding energy and mass defect for any nuclei.
[PY 1612.3] interpret the concept of subatomic particle and quarks.
[PY 1612.4] discuss the different kind of accelerators along with their merits and demerits.
[PY 1612.5] recognize the different type detectors.
[PY 1612.6] describe the nuclear fusion and fission processes which make them employable in relevant field.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

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E. SYLLABUS

Nuclear Properties and Energy: Mass, radius, angular momentum, magnetic moment, electric quardrupole moment, parity, Coulomb scattering of a charged particle by nucleus (Rutherford Scattering - qualitative discussion only) properties of nuclear forces, Binding energy, mass effect, Liquid drop model, semi empirical mass formula; **Subatomic particles:** Properties of particles, classification in to leptons mesons and baryons, matter and antimatter, conservation laws (qualitative discussion) energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin, strangeness, fundamental quark structure of baryons; **Particle Accelerator**: Principle and working of linear accelerators -cyclotron, synchrotron, discussion of relation between particle energy and radius and magnetic field, Electron synchrotron, Proton synchrotron, betatron; **Nuclear Detectors**: Ionization chamber, proportional counter, scintillation counter, Geiger counter, brief discussion on solid state detectors; **Nuclear Fission and Fusion:** Energy release in nuclear fission and fusion, Liquid Drop Model, Qualitative discussion of elements of a nuclear reactor, uncontrolled nuclear reaction, Carbon- nitrogen and proton- proton cycle.

F. TEXT BOOKS

T1. Kaplan I, Nuclear Physics, Narosa Pub. (2002).

T2. Tayal D C, Nuclear Physics, Himalaya Pub. House, Bombay (2015).

T3. Ghoshal S N, Nuclear Physics, S. Chand (2010).

G. REFERENCE BOOKS

R1. Singru R M, Introduction to experimental Nuclear Physics, Wiley Eastern Pvt. Ltd. (1972).

R2. Arora C L, Refresher Courses in Physics, Vol.-III, S. Chand (2010).

H. LECTURE PLAN

Lec No	**Topics**	**Session Outcome**	**Mode of Delivery**	**Corresponding CO**	**Mode of Assessing the Outcome**
1	Discussion of Lecture Plan	To acquaint and clear teachers expectations and understand student expectations	Lecture	NA	NA
	Nuclear Properties and Energy				
2-3	Mass, radius, angular momentum, magnetic moment	Recall basics of nuclear physics	Flipped Classroom	PY1612.1	In Class Quiz (Not Accounted) Mid term I
4-5	Electric quardrupole moment, parity, Coulomb scattering of a charged particle by nucleus	Understand the moment, parity and coulomb scattering	Lecture	PY1612.1	In Class Quiz Mid term I End Term
6	**TUTORIAL:1**		Activity		
7-8	Properties of nuclear forces, Binding energy, mass effect	interpret the properties of nuclear forces, Binding energy, mass effect	Lecture	PY 1612.2	In Class Quiz Mid term I End Term
9-10	Liquid drop model, semi empirical mass formula	Understand the basics of Liquid drop model, semi empirical mass formula	Lecture (Think Pair Share)	PY 1612.2	Class Quiz Mid Term I End Term
11	**TUTORIAL:2**		Activity	PY 1612.2	
	Sub atomic Particles				
12-14	Properties of particles, classification in to leptons mesons and baryons, matter and antimatter	Describe the elementary particles	Flipped Class	PY 1612.2	Home Assignment Class Quiz Mid Term 1 End Term
15-19	Conservation laws (qualitative discussion) energy, momentum, angular momentum, charge, lepton number, Baryon number, Isospin,	Understand the conservation laws	Activity (Think Pair Share)	PY 1612.2	Class Quiz Mid Term 1 End Term

	strangeness, fundamental quark structure of baryons.				
20	**TUTORIAL: 3**		Activity	PY 1612.2	
	Particle Accelerators				
21-22	Principle and working of linear accelerators cyclotron	Describe the Principle and working of linear accelerators	Lecture	PY 1612.2	Class Quiz End Term
23-25	Synchrotron betatron, Electron synchrotron, Proton synchrotron	Describe the Principle and working of linear accelerators	Audio-Video	PY 1612.4	Class Quiz Mid Term II End Term
26	**TUTORIAL:4**		Activity	PY 1612.4	
	Nuclear Detectors				
27-28	Ionization chamber, proportional counter and Geiger counter	Describe working of detector	Lecture, Activity	PY 1612.5	Class Quiz Mid Term II End Term
29	Scintillations and Solid state Detectors				
	Nuclear Fission and Fusion				
30	Energy release in Nuclear fission and fusion	Describe the different energy phenomenon	Lecture	PY 1612.5	Class Quiz Mid Term II End Term
31	Liquid Drop Model	Understand the different nuclear model	Lecture	PY 1612.5	Class Quiz End Term
32	**TUTORIAL:5**		Activity	PY 1612.5	
33	Qualitative discussion of elements of a nuclear reactor	Understand the different nuclear reactors	Flipped Class	PY 1612.5	Class Quiz End Term
34-36	Uncontrolled reaction, and atomic bomb	Understand the basics of atomic bomb	Lecture	PY 1612.5	Class Quiz End Term
37-39	Carbon- nitrogen and proton- proton cycle.	Understand the basics of C-N cycle and P-P cycle	Lecture	PY 1612.5	Class Quiz End Term
40	**TUTORIAL:6**		Activity	PY 1612.5	

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

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		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
PY 1612.1	describe the nuclear properties and models of nuclear physics.	2							2			
PY 1612.2	calculate the binding energy and mass defect for any nuclei.							2			2	2
PY 1612.3	interpret the concept of subatomic particle and quarks.						2					
PY 1612.4	discuss the different kind of accelerators along with their merits and demerits.								2			
PY 1612.5	recognize the different type of detectors.						2					1
PY 1612.6	describe the nuclear fusion and fission processes.			2						2		

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation