



MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics
Course Hand-out

Calculus II | MA 1103 | 4 Credits | 3 | 0 4

Session: July –Dec. 2017 | Faculty: Dr. Giriraj| Class: B.Sc (Hons)

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's interests and aspirations.

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

[1103.1] identify, evaluate, integrate and apply concepts of successive differentiation, limits, continuity and differentiability in real world problems

[1103.2] rational attitude will be developed after studying Mean value theorem, curvature, asymptotes and curve tracing and cultivate habit of drawing conclusions based on quantitative information.

[1103.3] enhance analytical and logical skills

[1103.4] solve industry related and medical problems

B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

[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

C. 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.	

D. SYLLABUS**Calculus-I**

Successive differentiations: Successive differentiation; n^{th} derivatives of functions; Leibnitz theorem and its applications. Limits, continuity and mean value theorems: 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; Evaluation of limits by L'Hospital's rule; Derivatives of arcs: Polar coordinates; Angle between the radius vector and the tangent; Angle of intersection of curves (polar form); Polar sub tangent and polar subnormal; Perpendicular from pole on the tangent; Pedal equations; Derivative of an arc in Cartesian; parameter and polar forms; Equation of a conic in polar form; 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.

E. TEXT BOOKS

1. Shanti Narayan and P. K. Mittal, Differential Calculus, S. Chand & Company Ltd., New Delhi, 2011.
2. P. Saxena, Differential Calculus, McGraw Hill (India), New Delhi, 2014.

F. REFERENCE BOOKS

1. G. B. Thomas and R. L. Finney, Calculus and Analytical geometry, 10th Ed. Addison Wesley, 2000.
2. S. Narayanan & T. K. Manicavachagom Pillay, Calculus I & II, S. Viswanathan Pvt. Ltd., Chennai, 2010.

Lecture Plan:

LEC NO	TOPICS
1,2	Successive differentiations: Successive differentiation; n^{th} derivatives of functions
3,4	Leibnitz theorem and its applications
5,6,7	Definition of limit and continuity; Types of discontinuities
8,9,10	Properties of continuous functions on a closed interval; Differentiability
11,12,13,14	Rolle's theorem; Lagrange's and Cauchy's first mean value theorems
15,16,17	Taylor's theorem (Lagrange's form); Maclaurin's theorem and expansions;
18,19	Evaluation of limits by L'Hospital's rule
20,21	Derivatives of arcs: Polar coordinates
22,23,24,25	Angle between the radius vector and the tangent; Angle of intersection of curves (polar form); Polar sub tangent and polar subnormal
26,27	Perpendicular from pole on the tangent; Pedal equations;
28,29,30	Derivative of an arc in Cartesian; parameter and polar forms; Equation of a conic in polar form
31,32,33,34	curvature of plane curves; Formula for radius of curvature in Cartesian, parametric, polar and pedal Forms
35,36	Centre of curvature
37,38,39	Asymptotes
40,41,42,43,44,	Singular points; Cusp, node and conjugate points; Tracing of standard Cartesian, polar and parametric curves.
45,46,47,48	Evolutes and involutes; Envelopes

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

CO	STATEMENT	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES										
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	PSO 1	PSO 2	PSO 3	
MA1 103	identify, evaluate, integrate and apply concepts of successive differentiation, limits, continuity and differentiability in real world problems	3							2			1
MA1 103	rational attitude will be developed after studying Mean value theorem, curvature, asymptotes and curve tracing and cultivate habit of drawing conclusions based on quantitative information.		2	2						2		
MA1 103	enhance analytical and logical skills				2	2					1	
MA1 103	solve industry related and medical problems						2					

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

H. Course Outcome Attainment Level Matrix:

CO	STATEMENT	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	PSO4
MA 1103	identify, evaluate, integrate and apply concepts of successive differentiation, limits, continuity and differentiability in real world problems											
MA 1103	rational attitude will be developed after studying Mean value theorem, curvature, asymptotes and curve tracing and cultivate habit of drawing conclusions based on quantitative information											
MA1103	enhance analytical and logical skills											
MA1103	solve industry related and medical problems											

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

Higher trigonometry and Difference Equations| MA 1104| 4 Credits | 3 | 0 4

Session: August 17 – December 17 | Faculty: Poonia L | Class: Compulsory (closed book)

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 Moivre'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

[1104.1] Recognize an exponential function and Solve problems involving applications of exponential functions

[1104.2] Solve an elementary logarithmic equation, apply the properties of logarithms. Solve applications involving logarithms

[1104.3] Employ De Moivre's theorem in a number of application, understand more clearly the argument $\arg(z)$ of a complex number, obtain complex roots of complex numbers

[1104.4] Formulate difference equation for real world problems, solve linear difference equation with constant coefficients.

[1104.5] Solve linear difference equations with variable coefficients, solve simultaneous difference equations.

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)	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

MA1104 Higher Trigonometry and Difference Equations [3 1 0 4]

Higher trigonometry: 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 $(\cos x + i \sin x)^{p/q}$; Application of De-Moivre's theorem for integral and fractional indices; Expansion of $\sin(nx)$, $\cos(nx)$ in series of $\sin x$, $\cos x$; Definitions of logarithmic, exponential and hyperbolic functions; Inverse functions; Trigonometric and hyperbolic functions; Laws of logarithm; Summation of series. **Difference equations:** Introduction; Definitions; Formulation of difference equations; Order and degree of a difference equation; Linear difference equations, Rules for finding complementary function; Rules for finding particular integral; Difference equations reducible to linear form; Simultaneous difference equations with constants coefficients and its applications.

F. Text Books:

1. A. R. Mazumdar, A. Dasgupta and S. B. Prasad, Degree Level Trigonometry, Bharti Bhawan, Patna, 2012.

- R. P. Agarwal, Difference Equations and Inequalities: Theory, Methods and Applications, Marcel Dekker Inc., New York, 1992.

G. Reference Books:

- S. L. Loney, Plane Trigonometry, University of Michigan Library, 2005.
- R. K. Ghosh and K. C. Maity, Higher Algebra, New Central Book Agency, Kolkata, 2013.
- T. Veerarajan and T. Ramachandran, Numerical Methods, Tata McGraw Hill, New Delhi, 2009.
- W. G. Kelley and A. C. Peterson, Difference equations an introduction with applications, Second edition, Harcourt Academic Press, USA, 2001.

H. Lecture Plan:

LEC NO	TOPICS
1	Introduction and Course Hand-out briefing
2	Higher trigonometry – Introduction
3,4	De Moivre's theorem; Statement and proof
5,6	De Moivre's theorem for integral indices
7,8,9	Alternative method, Proof for rational indices
10,11,12	All possible values of $(\cos x + i \sin x)^{p/q}$
13,14,15	Application of De-Moivre's theorem for integral and fractional indices
16,17,18	Expansion of $\sin(nx)$, $\cos(nx)$ in series of $\sin x$, $\cos x$
19,20,21	Definitions of logarithmic , Inverse functions
22,23,24	exponential and hyperbolic functions
25,26	Trigonometric and hyperbolic functions
27,28,29	Laws of logarithm; Summation of series.
30	Difference equations: Introduction
31	Formulation of difference equations
32	Order and degree of a difference equation
33	Linear difference equations
34,35,36	Rules for finding complementary function
37,38,39	Rules for finding particular integral;
40,41,42	Difference equations reducible to linear form
43,44,45	Simultaneous difference equations with constants coefficients and its applications.

MA1104.2	Course Outcome statement		2	2								
MA1104.3	Course Outcome statement				2	2						
MA1104.4	Course Outcome statement						2					
MA1104.5	Course Outcome statement			1								

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

Descriptive Statistics| MSI 103 | 3 Credits | 2 | 0 3

Session: July 17 – Nov 17 | Faculty: Dr. Hemlata Joshi

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

[I 103.1]. collect appropriate data from the field for the empirical study.

[I 103.2]. completely describe a data set using appropriate descriptive statistics.

[I 103.3]. demonstrate knowledge of, and applications of, appropriate descriptive statistical tools to the data set.

[I 103.4]. construct and analyze graphical displays to summarize data.

[I 103.5]. interpret a set of descriptive statistics results and understand the limitations of each measure.

[I 103.6]. 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: 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.

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- 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. **Theory of Attributes:** Dichotomy of data, class frequencies, order of class frequencies, consistency of data, independence and association of attributes, Yule's coefficient of association and coefficient of colligation.

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:

Description of the syllabus	No of Hours Allotted	Cumulated lectures
Introduction to Statistics: Definition, Scopes, uses and limitations	1	1
Types of data: Qualitative and quantitative data, nominal and ordinal data, time series data, discrete and continuous data, frequency and non-frequency data	1	2
Collection of data: collection of primary and secondary data –its major sources, classification and tabulation of data	1	3
TUTORIAL CLASS – I	1	4
Presentation of data: frequency distribution and cumulative frequency distribution	2	6
Diagrammatic representation of data	1	7
Graphical representation of data	1	8
TUTORIAL CLASS – II	1	9
ASSIGNMENT I		
Measures of central tendency and location: Arithmetic mean its properties, applications and its merits and demerits	1	10
Geometric mean and Harmonic mean their properties, applications and their merits and demerits	1	11
Median its properties, applications and its merits and demerits	1	12
TUTORIAL CLASS – III	1	13
Mode its properties, applications and its merits and demerits	1	14
Partition values-quartiles, deciles, percentiles and their graphical location along with their properties, applications and their merits and demerits	2	16

TUTORIAL CLASS – IV	1	17
ASSIGNMENT II		
Measures of dispersion: Characteristics for an ideal measure of dispersion, absolute and relative measure of dispersion, range, coefficient of range, properties of range	1	18
Inter quartile range, quartile deviation, coefficient of quartile deviation and properties	1	19
Mean deviation, coefficient of mean deviation and properties	1	20
Standard deviation, coefficient of standard deviation and properties	1	21
TUTORIAL CLASS – V	1	22
ASSIGNMENT III		
Moments, Skewness and Kurtosis: moments about mean, moments about any point and their relationship	2	24
Effect of change of origin and scale, Sheppard’s correction for moments	1	25
Charlier’s checks	1	26
Coefficient of skewness and Kurtosis with their interpretations	1	27
TUTORIAL CLASS – VI	1	28
Theory of Attributes: Dichotomy of data, class frequencies, order of class frequencies	2	30
Consistency of data	2	32
Independence and association of attributes	2	34
Yule’s coefficient of association	1	35
Coefficient of colligation	1	36
TUTORIAL CLASS – VII	1	37
ASSIGNMENT IV		
END SEMESTER EXAMINATION		

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
MS1103.1	collect appropriate data from the field for the empirical study	2	2	1	2	1			2		2	3
MS1103.2	completely describe a data set using appropriate descriptive statistics	2	3		3				3	2	2	3
MS1103.3	demonstrate knowledge of, and applications of, appropriate descriptive statistical tools to the data set.	2	3	2	3				2	3	3	2
MS1103.4	construct and analyze graphical displays to summarize data	1	3		2				2		3	2
MS1103.5	interpret a set of descriptive statistics results and understand the limitations of each measure.	2	3		3				1		3	3

MS1103.6	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
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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	
MS1103.1	collect appropriate data from the field for the empirical study												
MS1103.2	completely describe a data set using appropriate descriptive statistics												
MS1103.3	demonstrate knowledge of, and applications of, appropriate descriptive statistical tools to the data set.												
MS1103.4	construct and analyze graphical displays to summarize data												
MS1103.5	interpret a set of descriptive statistics results and understand the limitations of each measure.												
MS1103.6	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.												

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

MANIPAL UNIVERSITY JAIPUR
School of Humanities and Social Sciences

Department of Economics
Course Hand-out

Micro Economics | EO 1101 | 4 Credits | 3 1 0 4

Session: Jul 16 – Dec 16 | Faculty: Dr. N.D. Mathur | Class: B.Sc. (Hons.) Semester I

Introduction: This course is offered by Dept. of Economics as core course, to give the students the insight to the concepts, principles and theories of microeconomics using verbal, graphical and simple mathematical techniques. The course aims to relate the specific facts and terminologies in the principles of microeconomics with the practical world problems, to enable students to discover and comprehend problems in the key areas using appropriate tools.

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

- [1101.1] Relate the micro-economic theory concepts to the practical world.
- [1101.2] Understand and interpret the prevailing market conditions
- [1101.3] Analyse the demand-supply scenario; production and cost scenario
- [1101.4] Illustrate the problems and solution for social and economic welfare of the country
- [1101.5] Describe the efficient distribution patterns for sustainable economy.

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

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	Assignments , Activity, etc.	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.	

SYLLABUS

Introduction to Economics and Consumer Behaviour: Nature scope and principles of economics; Methodology in economics; Scarcity and choice; choice by command and choice by market; the role of prices in a market economy. Meaning of Utility, Cardinal Utility Approach - Total and Marginal utility, law of diminishing marginal utility, Law of Equi-marginal utility, income and substitution effects; Ordinal Utility Approach, The consumption decision: preferences and their representation with indifference curves; budget constraints; consumer's optimum choice. Income Consumption Curve and price consumption curve, Price, substitution and income effect.

Theory of Demand and supply: Demand and its determinants. Giffen Goods, Individual demand and supply schedules and derivation of market demand and supply; shifts in demand and supply curves; concept of elasticity and its application; Engel curve, Applications of demand and supply: price rationing, price floors, consumer and producer surplus. **Production, Cost and Market Behaviour:** Production: production functions, law of variable proportions, returns to scale; isoquant and isocost lines, cost minimizing equilibrium condition. short run and long run costs, revenue and profit maximizations, short run industry supply curve, economies and diseconomies of scale, economies of scope, long run adjustments. Price –output determination in case of perfect competition, monopolistic competition, monopoly and oligopoly. **Theory of Distribution:**

Marginal productivity theory of distribution; Factor Pricing under perfect and imperfect competition in the labour market. Rent — Scarcity rent; Ricardian and Modern theory of Rent. Classical Theory of interest: Risk and uncertainty theory of Profit. **Welfare Economics:** Concept of Welfare Economics: Social Welfare Function, Pareto Optimality.

TEXT BOOKS

- H.L.Ahuja, *Advanced Economic Theory:Microeconomic Analysis*, S. Chand and Co. Limited, New Delhi, 2007
- P. Samuelson and Nordhaus, *Economics*, 19 th Edition, Tata McGraw-Hill, 2008.

REFERENCE BOOKS

- C. E. Case and C. Ray, *Principles of Economics*, Pearson Education, Inc., 8th edition, 2007.
- N. G. Mankiw, *Economics: Principles and Applications*, Cengage Learning India Private Limited, 4th edition, 2007.
- J. E. Stiglitz and C. E. Walsh, *Economics*, W.W. Norton & Company, Inc., New York, International Student Edition, 4th edition, 2007

Lecture Plan:

LEC NO	TOPICS
1	Nature scope and principles of economics
2,3	Methodology in economics; Scarcity and choice; choice by command and choice by market
4	The role of prices in a market economy
5,6,7	Meaning of Utility, Cardinal Utility Approach - Total and Marginal utility, law of diminishing marginal utility, Law of Equi-marginal utility, income and substitution effects
8,9,10,11,12	Ordinal Utility Approach, The consumption decision: preferences and their representation with indifference curves; budget constraints; consumer's optimum choice. Income Consumption Curve and price consumption curve, Price, substitution and income effect.
13	Theory of Demand and supply: Demand and its determinants
14,15	Giffen Goods, Individual demand and supply schedules and derivation of market demand and supply
16	shifts in demand and supply curves
17,18,19	Concept of elasticity and its application
20,21,22	Engel curve, Applications of demand and supply: price rationing, price floors, consumer and producer surplus
23,24,25	Production: production functions; law of variable proportions, returns to scale
26,27	Isoquant and isocost lines, cost minimizing equilibrium condition
28,29,30,31,32,33	Short run and long run costs, revenue and profit maximizations, short run industry supply curve, economies and diseconomies of scale, economies of scope, long run adjustments
34,35,36,37,38	Price –output determination in case of perfect competition, monopolistic competition, monopoly and oligopoly

39,40,41,42,43	Marginal productivity theory of distribution; Factor Pricing under perfect and imperfect competition in the labour market
44,45,46,47,48	Rent — Scarcity rent; Ricardian and Modern theory of Rent. Classical Theory of interest: Risk and uncertainty theory of Profit.
49,50,51,52	Concept of Welfare Economics: Social Welfare Function, Pareto Optimality

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

CO	STATEMENT	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	
EO 1101.1	Course Outcome statement	3										
EO 1101.2	Course Outcome statement		2	2								
EO 1101.3	Course Outcome statement				2	2						
EO 1101.4	Course Outcome statement						2					
EO 1101.5	Course Outcome statement			1								

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

Course Outcome Attainment Level Matrix:

CO	STATEMENT	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	
EO 1101.1	Course Outcome statement	3											
EO 1101.2	Course Outcome statement		2	2									
EO 1101.3	Course Outcome statement				2	2							
EO 1101.4	Course Outcome statement						2						
EO 1101.5	Course Outcome statement			1									

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



MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

DEPARTMENT OF BASIC SCIENCE

Course Hand-out

Fundamental of Computers | CS 1102 | 2 Credits | 2 0 0 2

Session: July 16- Dec 16 | Faculty: Anurag Bhatagar/ Harish Sharma | Class: BSc Hons / Pass (Maths)

Introduction: This course is offered by Department of Languages as a core course to the students of BA English Hons, in 1st Semester. This course is designed as a foundation course to make the students familiar with computers and their workings and with its various applications in graduate program of Arts. We will begin with a general overview of computer's model, usage then go into more detail about various concepts, tools used in computers.

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

- CO [CS 1102. 1] Understand the process of information processing in computer.
- CO [CS 1102. 2] To acquaint the students with fundamental aspects of computer technology.
- CO [CS 1102. 3] To become professional users of Office editing and formatting tools.
- CO [CS 1102. 4] To create awareness, interest & knowledge to further explore the growing potential of IT in real life.
- CO [CS 1102. 5] Understand the concepts and applications of computer networks.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Program Outcome

- [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

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	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. These works are graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

SYLLABUS

Introduction: Hardware Features and Uses: Components of a Computer, Generations of Computer, Primary & Secondary Storage Concepts, Data Entry Devices, Data Output Devices.

Software Concepts: System Software, Application Software, Language Classification, Compilers and Interpreters. Operating Systems.

Information Concepts and Processing: Microsoft Word, Power Point, Access and Excel proficiency.

TEXT BOOKS

1. Kahate A, *"Information Technology"*, Tata McGraw Hill Publication, 3rd Edition, 2007.
2. V. Raja Raman, *"Fundamental of Computers"*, PHI Learning, 5th Edition, 2006.
3. Reema Thareja, *"Fundamental of computers"*, oxford publication, 201

Lecture Plan:

Unit	Session No.	Portion to be covered	Instrument	Learning Outcome
	1.	Overview of the Course ➤ What is computer ➤ Why computers ➤ What are the limitations ➤ How it computes	Discussion + Board	Students will be able to understand computing environment.

1		<ul style="list-style-type: none"> ➤ What does it understand ➤ How it interacts 		
	2.	Quiz from session 1 <ul style="list-style-type: none"> ➤ What is data ➤ What is information ➤ Information concepts and processing 	Discussion + Board	Students will have a clear and detailed view regarding information processing
	3.	Quiz from session 2 <ul style="list-style-type: none"> ➤ Need, quality and value of information processing ➤ Data processing ➤ Difference between data and information 	Discussion + Board	Students will be able to distinguish between data and information and their processing mechanism
	4.	Quiz from session 3 <ul style="list-style-type: none"> ➤ Characteristics of computers ➤ Elements of computers ➤ Drawbacks of computers and artificial intelligence 	PPT + Discussion	Students will have a broad view about the computers and their different parts and their functionalities and limitations of computers.
	5.	Quiz from session 4 <ul style="list-style-type: none"> ➤ Review of whole unit 	Discussion + Board	Students can summarize the unit.
	6.	Quiz from session 5 Numbers Systems <ul style="list-style-type: none"> ➤ Binary Number system ➤ Decimal Number system 	Board	Students will be able to understand binary number system.
	7.	Quiz from session 6 Number system Continue <ul style="list-style-type: none"> ➤ Octal Number System 	Board	Students will be able to understand octal number system.
	8.	Quiz from session 7 Number System continue <ul style="list-style-type: none"> ➤ Hexadecimal Number system 	Board	Students will be able to understand hexadecimal number system.
	9.	Quiz from session 8 Number System continue <ul style="list-style-type: none"> ➤ Conversion from one number system to another 	Board	Students will be able to understand number system conversions.
	10.	Quiz from session 9 Number System continue <ul style="list-style-type: none"> ➤ 1's complement and 2's complement 	Board	Students will learn complement.
	11.	Quiz from session 10 Binary arithmetic <ul style="list-style-type: none"> ➤ Addition and subtraction 	Board	Students will learn addition and subtraction of binary numbers
		12.	Hardware features and uses <ul style="list-style-type: none"> ➤ Components of a computer 	PPT + Discussion
	13.	Quiz from session 12 <ul style="list-style-type: none"> ➤ Generation of computers 	PPT + Discussion	Students will know about generation of computers

2	14.	Quiz from session 13 ➤ Data entry Devices	PPT + Discussion	Students will know data entry devices
	15.	Quiz from session 14 ➤ Data output devices	PPT + Discussion	Students will know data output devices
	16.	Quiz from session 15 ➤ Memory devices ➤ Memory hierarchy ➤ Primary and secondary storage concepts	PPT + Discussion	Students will know data storage devices
	17.	Quiz from session 16 ➤ Processors	PPT + Discussion	Students will know processors and their functions.
	18.	Quiz from session 17 Software concept ➤ What is instruction ➤ What is program ➤ What is software	PPT + Discussion	Students will know about software
	19.	Quiz from session 18 Software concepts continue ➤ System software	PPT + Discussion	Students will know about system software
	20.	Quiz from session 19 ➤ Firmware ➤ Examples of firmware	PPT + Discussion	Students will know about firmware and their use
	21.	Quiz from session 21 ➤ Compilers and interpreters	PPT + Board	Students will know about two translators
	22.	Quiz from session 26 ➤ Part of a typical Window	PPT + Discussion	Students will know about parts of window
	23.	Quiz from session 27 ➤ Function of each part of a Window	PPT + Discussion	Students will know about functions of each part of window
	24.	Review of sessions 13 – 21	Presentation by students	
	25.	Review of sessions 22 to 29	Presentation by students	
	26.	Network Theory ➤ What is network ➤ Network topologies • BUS	PPT + Discussion	Students will know basics of network theory and bus topology
	27.	Quiz from session 31 • STAR • RING ➤ Types of Network • LAN	PPT + Discussion	Students will know two other topologies and one type of n/w i. e. LAN
28.	Quiz from session 32 Types of Network continues • MAN • WAN	PPT + Discussion	Students will have idea of MAN, WAN	

3	29.	Quiz from session 33 Network configuration Hardware: <ul style="list-style-type: none"> ➤ Servers ➤ Nodes ➤ Channels ➤ Fiber Optics 	PPT + Discussion	Students will have knowledge of various NCH's
	30.	Quiz from session 34 NCH continues <ul style="list-style-type: none"> ➤ Twisted cable ➤ Co- axial cables ➤ Hubs ➤ NIC: Network Interface Card 	PPT + Discussion	Students will have knowledge of various NCH's
	31.	Quiz from session 35 <ul style="list-style-type: none"> ➤ Arcnet ➤ Ethernet 	PPT + Discussion	Students will know Arcnet and Ethernet
	32.	Review of Whole Syllabus	PPT + Discussion	
	33.	Review of Whole Syllabus	Presentation by students	

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 O 1	PS O 2	PS O 3	PS O 4
CO [CS 1102. 1]	Understand the process of information processing in computer.		1									
CO [CS 1102. 2]	To acquaint the students with fundamental aspects of computer technology.		1									
CO [CS 1102. 3]	To become professional users of Office editing and formatting tools.	1	2									
CO [CS 1102. 4]	To create awareness, interest & knowledge to further explore the growing potential of IT in real life.	1	1	1		2	1					
CO [CS 1102. 5]	Understand the concepts and applications of computer networks.	1	1					2				

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

K. 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	PSO4
CO [CS 1102]	Understand the process of information processing in computer.											
CO [CS 1102]	To acquaint the students with fundamental aspects of computer technology.											
CO [CS 1102]	To become professional users of Office editing and formatting tools.											
CO [CS 1102]	To create awareness, interest & knowledge to further explore the growing potential of IT in real life.											
CO [CS 1102]	Understand the concepts and applications of computer networks.											

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



MANIPAL UNIVERSITY JAIPUR

School of Basic Science

DEPARTMENT OF BASIC SCIENCE

Course Hand-out

Fundamental of Computers LAB | CS 1132 | L-0 T-0 P-2 C-1

Session: July 16 – Dec 16 | Faculty: Anurag Bhatnagar / Harish Sharma | Class: BSc Hons / Pass (Maths)

Introduction: This course is offered by Department of Languages as a core course to the students of BA English Hons, in 1st Semester. This course is designed as a foundation course to make the students familiar with computers and their workings and with its various applications in graduate program of Arts. We will begin with a general overview of computer's model, usage then go into more detail about various concepts, tools used in computers.

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

- CO [CS 1102. 6] Understand the process of information processing in computer.
- CO [CS 1102. 7] To acquaint the students with fundamental aspects of computer technology.
- CO [CS 1102. 8] To become professional users of Office editing and formatting tools.
- CO [CS 1102. 9] To create awareness, interest & knowledge to further explore the growing potential of IT in real life.
- CO [CS 1102. 10] Understand the concepts and applications of computer networks.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Program Outcome

- [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

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Mid Term Viva	20
	Continuous Work Assignment / File	20
	Quizzes	10
End Term Exam (Summative)	End Term Exam (Practical + Viva)	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. These works are graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity classroom participation by a student will be assessed and marks will be awarded.	

SYLLABUS

Experiments and Assignments on Microsoft Word, Power Point, Access and Excel proficiency.
Usage of Computer Network and related tool,
Email, Social Media, Google Apps (Drive, Form, Groups etc.)

TEXT BOOKS

1. Kahate A, *"Information Technology"*, Tata McGraw Hill Publication, 3rd Edition, 2007.
2. V. Raja Raman, *"Fundamental of Computers"*, PHI Learning, 5th Edition, 2006.
3. Reema Thareja, *"Fundamental of computers"*, oxford publication, 2016

L. 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 O 1	PS O 2	PS O 3	PS O 4
CO [CS 1102. 6]	Understand the process of information processing in computer.	2	3		2	1		3				
CO [CS 1102. 7]	To acquaint the students with fundamental aspects of computer technology.	2	2		2		1	2				
CO [CS 1102. 8]	To become professional users of Office editing and formatting tools.	2	3	1	3	2	1	3				
CO [CS 1102. 9]	To create awareness, interest & knowledge to further explore the growing potential of IT in real life.	1	3		3	2	1	3				
CO [CS 1102. 10]	Understand the concepts and applications of computer networks.	2	2	2	2	1	2	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

General English| EN1101| 2 Credits {2 0 0 2}

Session: July 17 – Dec. 17 | Faculty: Dr Yashoda Verma | Year/Semester: I Year/ Common Paper I Semester

Introduction: This course is offered by Department of Languages as a core course to the students in 1st Semester. The course offers an in depth knowledge of Language as an important branch of English language studies. It covers basic concepts such as properties of human languages, word formation, Grammar, Comprehension and Composition. There is no specific prerequisite on the part of students as the course begins with the very basics of the field of study.

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

(EN1101.1) Understand the fundamental principles of effective communication skills and presentation skills.

(EN1101.2) Develop critical and creative thinking abilities for communicative competence.

(EN1101.3) Display enhanced competence in oral and written communication.

(EN1101.4) Improve ideas with precision and coherence in writing.

(EN1101.5) Recognize the importance of communication skills like listening, speaking, reading and writing with advancement of competitive world.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES –

[PO.1]. 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

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.	

SYLLABUS

Introduction to communication skills, Principles of Communication, modes of communication, types of communication, essential features of communication, Importance of effective communication: Its application, Barriers to effective communication, Reading, writing and listening skills, Sentence Patterns and its usage, Uses of Verbs: Finite and Non-Finite Verbs, Modal Verbs, Voice, Tenses – Its usage and sequence, Question Tags, Articles, Usage and its Application, Reported Speech, Synonyms and Antonyms/ One Word Substitution, Reading Comprehension, - Précis Writing ,Essay writing- Letter Writing-Letter content and layout, Personal, Professional Business Letter, Circulars ,Letter to Newspaper, Memo and Memo Reports-Usefulness and format, ,Job Application, Resume Writing(Latest trends in Resume Writing), Report Writing-Types and its Application. Group Discussion, Extempore and Presentations.

Reference Books:

- R. 1. C. Tickoo, J. Sasikumar, Writing with a Purpose, Oxford University Press.
- R. 2. G. David, Contemporary English Grammar, Structures and Composition, Macmillan Publications.
- R. 3. Jones Daniel, English Pronouncing Dictionary, ELBS London.
- R. 4. N. Krishnaswamy, Modern English: A Book of Grammar Usage and Composition, Macmillan India.
- R. 5. N.D. Turton & J.B. Heaton, Longman Dictionary of Common Errors, 1998.
- R. 6. M. McCarthy, English Idioms in Use, London: Cambridge University Press, 2002.
- R. 7. Quirk et. al, University Grammar of English, ELBS London.
- R. 8. S. Mishra & C. Muralikrishna, Communication Skills for Engineers, Pearson Education. 2004.

Lecture Plan:

LEC NO	TOPICS
1	Introduction to communication skills, Principles of Communication
2	modes of communication, types of communication
3	essential features of communication
3-4	Importance of effective communication: Its application, Barriers to effective communication
5	Reading, writing and listening skills
6	Sentence Patterns and its usage
7	Uses of Verbs: Finite and Non-Finite Verbs
8	Modal Verbs
9-10	Active passive voice
11-12	Tenses – Its usage and sequence
13	Question Tags, Articles, Usage and its Application
14-15	Reported Speech
16-17	Synonyms and Antonyms/ One Word Substitution
18-19	Reading Comprehension, Précis Writing ,Essay writing
20-21	Letter Writing-Letter content and layout, Personal, Professional Business Letter
22-24	Circulars, Letter to Newspaper, Memo and Memo Reports-Usefulness and format
25	Job Application, Resume Writing(Latest trends in Resume Writing)
26-27	Report Writing-Types and its Application
28	Group Discussion
29-30	Extempore and Presentations

EN 1101.4	Improve ideas with precision and coherence in writing.												
EN110 1.5	Recognize the importance of communication skills like listening, speaking, reading and writing with advancement of competitive world.												

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

Calculus II| MA 1203 | 4 Credits | 3 1 0 4

Session: Jan. -July | Faculty: Dr. Giriraj| Class: **B.Sc (Hons) Mathematics**

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's interests and aspirations.

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

[1203.1] identify, evaluate, integrate and apply concepts of differentiation, maxima and minima and integration in real world problems

[1203.2] rational attitude will be developed after studying applied mathematics related to differential and integral calculus and cultivate habit of drawing conclusions based on quantitative information.

[1203.3] enhance analytical and logical skills

[1203.4] solve industry related and medical problems

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

- **[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

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

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.	

SYLLABUS

Calculus-II

Partial differentiation: First and higher order derivatives; Differentiation of homogeneous functions; Euler’s theorem; Total derivative and differential; Differentiation of implicit functions and composite functions. **Taylor’s theorem:** Taylor’s theorem for functions of two variables; Maclaurin’s expansion in power series; Jacobian, evaluation of Jacobian. **Maxima & minima:** Maxima-minima for functions of two variables; Necessary and sufficient condition for extreme points. **Integral calculus:** Recapitulation of methods of integration and definite integral; 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. **Multiple integrals:** Double and triple integration of bounded functions on bounded domain; Change of order of double integration; Area and Volume; Change of variables.

TEXT BOOKS

- T1. Shanti Narayan and P. K. Mittal, Differential Calculus, S. Chand & Company Ltd., New Delhi, 2011
- T2 Shanti Narayan, Integral Calculus, S. Chand and Company Ltd., New Delhi, 2004.

REFERENCE BOOKS

- R1: S. Narayanan & T. K. Manicavachagom Pillay, Calculus I & II, S. Viswanathan Pvt. Ltd., Chennai, 2010.
- R2: N. P. Bali, Differential Calculus, Laxmi Publications (P) Ltd., New Delhi, India, 2010.

Lecture Plan:

		Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction of Subject	To acquaint and clear teachers expectations and understand student expectations	Lecture		
2,3	First and higher order derivatives; Differentiation of homogeneous functions	Learn to find derivatives	Lecture		
4,5,6	Euler's theorem; Total derivative and differential	Apply the concept of derivatives	Tutorial & Lecture	MA1101.1	
7,8,9	Differentiation of implicit functions and composite functions.	Solve problems of implicit and composite functions	Tutorial & Lecture		Home Assignment
10,11	Taylor's theorem: Taylor's theorem for functions of two variables	Understand the concept of expansion of functions	Lecture		
12,13	Maclaurin's expansion in power series;	Apply to expand various functions	Lecture		Home Assignment
14,15	Jacobian, evaluation of Jacobian	Apply derivatives	Tutorial & Lecture		
16,17,18	Maxima & minima: Maxima-minima for functions of two variables	Understand the concept of maxima and minima for two variables	Lecture		Home Assignment Class Quiz
19,20,21	Necessary and sufficient condition for extreme points	Solve problems	Lecture & tutorial	MA 1103.2	
22,23,24,25	Integral calculus: Recapitulation of methods of integration and definite integral; Reduction formulae	Understand and apply integration concept	Lecture		
26,27	Application of integral calculus; Length of arcs	Apply concept of integration to find length of curves	Lecture		
28,29,30	Surface areas and volumes of solids of revolutions for standard curves in Cartesian and polar forms	Apply concept of integration to find surface and volume of curves	Lecture & Tutorial		Home Assignment
31,32,33	Beta and Gamma functions: Beta and Gamma functions and relation between them	Define and apply beta and Gamma function	Lecture		

MA 1203	rational attitude will be developed after studying applied mathematics related to differential and integral calculus and cultivate habit of drawing conclusions based on quantitative information												
MA1203	enhance analytical and logical skills												
MA1203	solve industry related and medical problems												

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

Differential Equation-I | **MA1204** | 4 Credits | 3 | 0 4

Session: Jan 16 – May 16 | Faculty: Dr. Bhoopendra Pachauri | B.Sc. (Hons.) Sem-II

Introduction: A **differential equation** is a mathematical **equation** that relates some function with its derivatives. In applications, the functions usually represent physical quantities, the derivatives

represent their rates of change, and the **equation** defines a relationship between the two. The course is covered the first order and higher order differential equation with constant and variable coefficients.

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

- [1204.1]. An ability to generate the differential equations.
- [1204.2]. An ability to solve the first order and first degree differential equations
- [1204.3]. An ability to solve higher order differential equations with constant coefficients.
- [1204.4]. An understanding for finding the solution of second ordinary differential equation with variable coefficient.
- [1204.5]. A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.

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

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.

SYLLABUS

Ordinary differential equations: Order and degree of a differential equation; Linear and non-linear differential equations; Formation of differential equations; General, particular and singular solution; Wronskian; Its properties and applications; Linear dependence and independence. **Equations of first order and first degree:** Variable separable method; Homogeneous equations; Equations reducible to homogeneous form; Linear equations and equations reducible to linear form; Exact equations; Integrating factor; Equations reducible to exact form; orthogonal trajectories in Cartesian coordinates; Some 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 Clairaut's form; Singular solution. **Higher order linear differential equations:** Linear equations with constant coefficients; Complementary function; Particular integral of the forms e^{ax} , $\sin ax$, $\cos ax$, x^m , $e^{ax}V$, x^mV ; Cauchy's homogeneous equation.

TEXT BOOKS

J. L. Bansal, S. L. Bhargava and S. M. Agarwal, Differential Equations, Jaipur Publishing House, Jaipur, 2012.

M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Comp., New Delhi, 2013

REFERENCE BOOKS

S. L. Ross, Differential Equations, Wiley India, 2013.

E.A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 2011.

R. K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, 4th Edition, Narosa Publishing House, 2014.

G. F. Simmons, Differential Equations, Tata McGraw-Hill, 2006.

Lecture Plan:

LEC NO	TOPICS
1	Introductory part of the differential equations.
3	First order and first degree differential equations, variable separable form and homogeneous form
9	Reducible to homogeneous form, Linear differential equations and reducible to linear differential equations
10	Tutorial Class-I
	Assignment-I

MA 1204. 2	A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations , which involve less amount of labour and best suited for computer operations.											
MA 1204. 3	An ability to solve eigenvalue problems using numerical methods.											
MA 1204. 4	An understanding for finding the numerical solution of ordinary differential equation.											
MA 1204. 5	A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.											

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

PROBABILITY AND RANDOM VARIABLES | MS1204 | 3 Credits | 2 1 0 3

Session: Jan. 17 – May 17 | Faculty: **Dr. Monika Saini** | Class: B.Sc. /B.A. II Sem.

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.

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

- 1204.1** Understand the concept of probability theory for decision making
- 1204.2** Understand conceptual framework of random variables.
- 1204.3** Understand conceptual framework of mathematical expectations
- 1204.4** Understand conceptual framework of generating functions.

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

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.	

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 of origin and scale. Characteristic function, properties of characteristic function, uniqueness theorem. Probability generating function.

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.

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.

Lecture Plan:-

S. No.	Cumulati ve Lecture	Description of the syllabus
1.	L-1, 2	Random experiments, sample space, event, algebra of events,
2.	L-3	Definitions of Probability
3.	L-4-8	Theorems on probability
4.	L-9	Boole's inequality
5.	L-10-11	Conditional probability, independent events
6.	L-12	Bayes theorem
7.	L-13	Test
8.	L-14	Random Variable, distribution function, discrete random variable

9.	L-15-16	probability mass function, distribution function of discrete random variable, continuous random variable, probability density function, distribution function of continuous random variable
10.	L-17-21	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.
11.	L-22-23	Definition, expected value of random variable, expected value of a function of a random variable,
12.	L-24-25	addition and multiplication theorems and their generalizations, covariance,
13.	L-26	expectation and variance of a linear combination of random variable
14.	L-27	Cauchy-Schwartz inequality
15.	L-28	Conditional expectation
16.	L-29	conditional variance
17.	L-30	Definition, limitations and properties of moment generating function
18.	L-31	uniqueness theorem
19.	L-32-33	cumulates, properties of cumulates, effect of change or origin and scale
20.	L-34	Characteristic function, properties of characteristic function
21.	L-35	uniqueness theorem
22.	L-36-37	Probability generating function.

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	PS O 1	PS O 2	PS O 3	PS O 4
MS1204 .1	Understand the concept of probability theory for decision making	2			2			3				
MS1204 .2	Understand conceptual framework of random variables		2	3		2						

MS1204 .3	Understand conceptual framework of mathematical expectations	2		3			1					
MS1204 .4	Understand conceptual framework of generating functions		3		2			3				

2-

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

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	
MS1204.1	Understand the concept of probability theory for decision making												
MS1204.2	Understand conceptual framework of random variables												
MS1204.3	Understand conceptual framework of mathematical expectations												
MS1204.4	Understand conceptual framework of generating functions												

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

MANIPAL UNIVERSITY JAIPUR

School of Humanities and Social Sciences

Department of Economics

Course Hand-out

Macroeconomics| EO I202| 4 Credits | 3 | 0 4

Session: Jul 16 – Dec 16 | Faculty: Dr. Oum Kumari R | Class: B.Sc. (Hons.) Semester II

Introduction: This course aims to introduce the first year students to the basic concepts of macroeconomics. This course discusses the preliminary concepts associated with the determination and measurement of aggregate macroeconomic variable like savings, investment, GDP, money, inflation, and the balance of payments. It explores various possibilities emerging in an economy, and the role of policy in this context.

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

[1112.1] Understand the implications of interference in a market economy, including government policy

[1112.2] Describe the basics of national income accounting

[1112.3] Discuss the causes and consequences of business cycles

[1112.4] Analyze the roles of fiscal and monetary policy in fighting recessions and inflation

[1112.5] Apply economic reasoning to understand the operation of an economy

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

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	Sessional Exam I	20
	Sessional Exam II	20
	Assignments , Activity, etc.	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.	

SYLLABUS

Introduction to Macroeconomics and National Income Accounting Basic issues studied in macroeconomics; measurement of gross domestic product; income, expenditure and the circular flow; real versus nominal GDP; price indices; national income accounting for an open economy; balance of payments:

current and capital accounts **Money** Functions of money; quantity theory of money; determination of money supply and demand; credit creation; roles and objectives of central banks, qualities of effective central banks; tools of monetary policy **Inflation** Inflation ; measurement of inflation; cost push & demand pull inflation; hyperinflation; disinflation; Phillips curve **The Closed Economy in the Short Run** Classical and Keynesian systems; simple Keynesian model of income determination; Fiscal and monetary multipliers **Macro -economic policy objectives** The centrality of growth; Difference between actual GDP and Potential GDP; Determinants of a country's growth- sources, measurement and sustainability of economic growth.

TEXT BOOKS

Dornbusch, Fischer and Startz, Macroeconomics, McGraw Hill, 2010.

H L Ahuja, Macro Economics, S Chand, 2010

REFERENCE BOOKS

Stiglitz and Walsh, *Economics*, Fourth Edition, W. W. Norton, 2005.

N. Gregory Mankiw. *Macroeconomics*, Worth Publishers, 2010.

Olivier Blanchard, *Macroeconomics*, Pearson Education, Inc., 2009.

Lipsey & Chrystal, *Economics*, Oxford University Press, 2011.

Richard T. Froyen, *Macroeconomics*, Pearson Education Asia, 2005.

Lecture Plan:

LEC NO	TOPICS
1	Introduction to Macro Economics
2,3	Issues related to Macro Economics
4,5,6,7	Circular flow of Income Two Three and Four Sector Models, Significance, Leakages and Injections.
8,9,10,11,12,13	Measurement of gross domestic product; income, expenditure and the circular flow; real versus nominal GDP; price indices; national income accounting for an open economy.
14,15	Balance of payments: current and capital accounts
16,17,18,19,20	Money Functions of money; quantity theory of money; determination of money supply and demand;
21,22,23,24,25	Credit creation; roles and objectives of central banks, qualities of effective central banks; tools of monetary policy
26,27,28,29	Inflation , measurement of inflation; cost push & demand pull inflation; hyperinflation; disinflation; Phillips curve
30,31	Causes and Consequences of Inflation
32,33,34	The Closed Economy in the Short Run Classical and Keynesian systems; simple Keynesian model of income determination;

Course Outcome Attainment Level Matrix:

CO	STATEMENT								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
EO1112.1	Understand the implications of interference in a market economy, including government policy	3										
EO1112.2	Describe the basics of national income accounting		2	2								
EO1112.3	Discuss the causes and consequences of business cycles				2	2						
EO1112.4	Analyze the roles of fiscal and monetary policy in fighting recessions and inflation						2					
EO1112.5	Apply economic reasoning to understand the operation of an economy			1								

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



MANIPAL UNIVERSITY JAIPUR

School of Basic Science

Department of Chemistry

Course Hand-out

Environmental Science | CY 1120 | 3 Credits | 3 0 0 3

Session: Jan 17 – May 17 | Faculty: Naveen Kumar Singh | Class: Compulsory Course

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, 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.

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

- [1120.1] To help students acquire awareness and sensitivity to environmental and its allied problems.
- [1120.2] To help students acquire skills for identifying and solving environmental problems.
- [1120.3] Student would be able to find out the environmental problems concerning with human activities and developmental processes.
- [1120.4] Students could understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.

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

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.	

SYLLABUS

INTRODUCTION TO ENVIRONMENTAL STUDIES 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, Forest, Grassland, Desert and Aquatic (Ponds, Streams, Lakes, River, Oceans, Estuaries) ecosystem **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 of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation; Endangered and endemic species of India, Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: *In-situ* and *Ex-situ* conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value; **ENVIRONMENTAL POLLUTION** Environmental Pollution: type, causes, effects, and controls; Air, Water, Soil and Noise pollution, Nuclear hazards and human health risks, ill effects of

fireworks, Solid waste management: control measures of urban and industrial waste, pollution case studies
ENVIRONMENTAL POLICIES & PRACTICES Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment laws; Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act; International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context
HUMAN COMMUNITIES AND THE ENVIRONMENT Human population growth: impact on environment, human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management: flood, earthquake, cyclone and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan, Environmental ethics: Role of Indian and other religions and cultures in environmental conservation, Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). **Field Work** and visit.

TEXT BOOKS

1. Rajagopalan, R., Environmental Studies: From Crisis to Cure, Oxford University Press, 2016.
2. De, A. K. *Environmental Studies*, New Age International Publishers, New Delhi, 2007.
3. Bharucha, E., *Text book of Environmental Studies for undergraduate courses*, Universities Press, Hyderabad, 2nd Edition, 2013.

REFERENCE BOOKS

1. Gadgil, M., & Guha, R. *This Fissured Land: An Ecological History of India*. Univ. of California, Press, 1993.
2. Carson, R. *Silent Spring*. Houghton Mifflin Harcourt, 2002.
3. Groom, Martha J., Gary, K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.
4. Singh, J.S., Singh, S.P., Gupta, S.R. *Ecology, Environmental Science and conservation*. S. Chand Publishing, New Delhi, 2014.
5. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). *Conservation Biology: Voices from the Tropics*. John Wiley & Sons, 2013.

Lecture Plan:

LEC NO	TOPICS
1	Introduction to Environmental Studies: multidisciplinary nature of environmental studies
2	Scope and importance, concept of sustainability and sustainable development
3,4	Ecosystem: concept, structure and function, Energy flow in an ecosystem, food chain, food webs
5,6	Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem (Ponds, Streams, Lakes, River, Oceans, Estuaries)
7,8	Ecological succession, Natural Resources (Renewable & Non Renewable Resources): Land Resources and land use change, Land degradation
9	Soil erosion and desertification
10	Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations
11	Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
12	Energy resources: Renewable and Non- renewable energy sources
13	Use of alternate energy sources
14	Growing energy needs, case studies
15,16	Biodiversity and conservation: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India
17	Biodiversity patterns and global biodiversity hot spots

18	India as a mega-biodiversity nation; Endangered and endemic species of India
19	Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions
20	Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and informational value
21	Conservation of biodiversity: <i>In-situ</i> and <i>Ex-situ</i>
22	Environmental pollution: type, causes, effects, and controls of Air Pollution
23	ill effects of fireworks , Controls of Air Pollution
24	Type, causes, effects of Water Pollution
25	Controls of Water Pollution
26	Causes, effects of Soil and Noise Pollution, Nuclear hazards and human health risks
27	Solid waste management: control measures of urban and industrial waste
28,29	Pollution case studies, Environmental Policies & Practices: Climate change and global warming, International agreements: Kyoto protocols and Convention on Biological Diversity (CBD)
30,31	Ozone layer depletion, Montreal protocols, Acid rain and impacts on human communities and agriculture
32,33	Environment laws; Water (Prevention and control of Pollution) Act, Air (Prevention and Control of Pollution) Act, Environmental Protection Act,
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
36, 37	Human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management: flood, earthquake, cyclone and landslides
38	Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan,
39, 40	Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Revision on Ecosystem and Natural Resources
41-42	Revision on Biodiversity & Conservation, Environment Pollution and Environmental Policies

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM									
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	
CY I120.1	To help students acquire awareness and sensitivity to environmental and its allied problems.			3				2		1	
CY I120.2	To help students acquire skills for identifying and solving environmental problems.	2		1	1	3				1	
CY I120.3	Student would be able to find out the environmental problems concerning with human activities and developmental processes.			2						2	
CY I120.4	Students could understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.	3				2		3		1	

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

Course Outcome Attainment Level Matrix:

CO	STATEMENT	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	
CY 1120.1	To help students acquire awareness and sensitivity to environmental and its allied problems.												
CY 1120.2	To help students acquire skills for identifying and solving environmental problems.												
CY 1120.3	Student would be able to find out the environmental problems concerning with human activities and developmental processes.												
CY 1120.4	Students could understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.												

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



Three Dimensional Geometry | MA 1309 | 4 Credits | 3 1 0 4

Session: July –Dec. 2016 Faculty: Dr. Giriraj| Class: **B.Sc (Hons) Mathematics**

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's interests and aspirations.

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

[1309.1] to explain more ideas of conics

[1309.2] find the equation to tangent, normal at a point on a conic

[1309.3] apply sphere, cone and cylinder concepts to real world problems

[1309.4] develop attitude for hyperboloid of one sheet and two sheet and connect it with generating lines.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

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

- **[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

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.	

SYLLABUS: Three Dimensional Geometry

Spheres: Definition; Equation of a sphere; General equation of a sphere; Centre and radius of a sphere; Great Equation of a circle; Diameter form of the equation of a sphere; 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 present a cone; Intersection of a line and a plane; Angle between the intersecting lines of cone; Tangent plane; Reciprocal cone; Right circular cone. **Cylinder:** Definition; Equation of a cylinder; Enveloping cylinder; Right circular cylinder. **Central Conicoids:** The Standard equation; The ellipsoid; The hyperboloid of one sheet; The hyperboloid of two sheets; Diametral planes and conjugate diameter; Tangent planes, Normal, Cubic curve through the feet of the normals. **Generating Lines:** Developable surface; Skew surface; Generating lines of central conicoid; System of generating lines; Equation of generator through one point and two points on the principle elliptic section of a hyperboloid of one sheet.

TEXT BOOKS

T1 P. K. Jain and K. Ahmad, A Text book of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd., 2003.

T2 A. R. Vashishtha and D. C. Agarwal, Analytical Geometry of three dimensions, Krishna Prakashan, 2010.

REFERENCE BOOKS

R1 S. L. Loney, The Elements of Coordinate Geometry, Macmillan and Company, London, 2012.

R2 E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 1999

A. Lecture Plan:

		Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction of Subject	To acquaint and clear teachers expectations and understand student expectations	Lecture		
2,3,4	Spheres: Definition; Equation of a sphere; General equation of a sphere; Centre and radius of a sphere	Learn about sphere	Lecture		
5,6,7	Great Equation of a circle; Diameter form of the equation of a sphere	Apply the concept of sphere	Tutorial & Lecture	MA1309.1	
8,9	Tangent line and tangent plane of a sphere; Condition of tangency for a line and equation of tangent plane;	Solve problems of sphere	Tutorial & Lecture		Home Assignment
10,11	Angle of intersection of two spheres; Condition of orthogonality of two spheres.	Understand the concept of spheres	Lecture		
12,13,14	Cone: Cone; Quadratic cone; Equation of a cone;	Apply to physical problem	Lecture		Home Assignment
15,16	Enveloping cone; Condition for general equation of second degree to present a cone	Apply concept of cone	Tutorial & Lecture		

17,18,19	Intersection of a line and a plane; Angle between the intersecting lines of cone;	Understand the concept of line and plane intersection	Lecture		Home Assignment Class Quiz
20,21	Tangent plane; Reciprocal cone; Right circular cone	Solve problems	Lecture & tutorial	MA 1309.2	
22,23,24,25	Cylinder: Definition; Equation of a cylinder;	Understand and apply cylinder	Lecture		
26,27,28	Enveloping cylinder; Right circular cylinder.	Apply concept of right circular cylinder	Lecture		
29,30,31,32,33	Central Conicoids: The Standard equation; The ellipsoid; The hyperboloid of one sheet	Understand and Apply concept of conicoids	Lecture & Tutorial		Home Assignment
34,35,36,37	The hyperboloid of two sheets; Diametral planes and conjugate diameter; Tangent planes	Define and apply hyperboloid of one & two sheet	Lecture		
38,39,40	Normal, Cubic curve through the feet of the normals.	Apply normals	Lecture & Tutorial		Assignment
41,42,43	Generating Lines: Developable surface;	Illustrate concept of developable	Lecture & Tutorial		Home assignment
44,45,	System of generating lines	Apply generating lines	Lecture		
46	Skew surface; Generating lines of central conicoid	Understand skew lines	Lecture		
47,48	Equation of generator through one point and two points on the principle elliptic section of a hyperboloid of one sheet.	Understand to use concept of generator vis a vis hyperboloid	Lecture		

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT												
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	PSO 1	PSO 2	PSO 3	PSO4	
MA1 309	to explain more ideas of conics	1	1		1			2	1				
MA1 309	find the equation to tangent, normal at a point on a conic			2	1	3				2			2
MA1 309	apply cone and cylinder concepts to real world problems			1	1		2	1				2	
MA1 309	develop attitude for hyperboloid of one sheet and two sheet and connect it with generating lines.	1	1		2					1			

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

Course Outcome Attainment Level Matrix:

CO	STATEMENT												
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO4	
MA 1309	to explain more ideas of conics	3											
MA 1309	find the equation to tangent, normal at a point on a conic												
MA1309	apply cone and cylinder concepts to real world problems												
MA1309	develop attitude for hyperboloid of one sheet and two sheet and connect it with generating lines.												

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

Numerical Analysis | MA1310 | 4 Credits | 3 | 0 4

Session: Aug 16– December 16 | Faculty: Dr. Ashish Kumar | Class: B.Sc.-III Sem.

Introduction: The Graduate shall be 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.

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

- [1310.1]. An ability to solve numerical methods for finding the real roots of algebraic and transcendental equation. Which provides us with a technique to find an approximate but accurate solutions to a mathematical problem.
- [1310.2]. A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations, which involve less amount of labour and best suited for computer operations.
- [1310.3]. An ability to solve eigenvalue problems using numerical methods.
- [1310.4]. An understanding for finding the numerical solution of ordinary differential equation.
- [1310.5]. A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.

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

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.	

SYLLABUS

Numerical analysis: Introduction; Errors in Numerical computation: Gross error, Round off error, Truncation error; Approximate numbers; Absolute, relative and percentage error. **Operators:** Δ , ∇ , E , μ , δ (Definitions and simple relations among them). **Finite differences:** Differences; Operators; Forward and backward difference tables; Factorial polynomial; Error propagation in difference table. **Interpolation (for equal intervals):** Newton's forward and backward formulae equidistant terms with one or more missing values; Central differences and central differences table; Gauss forward and backward formulae; Stirlings and Bessel formula. **Interpolation (for unequal intervals):** Divided differences; Properties; Relations between divided differences and forward differences; Newton's divided differences formula; Lagrange's formula and inverse interpolation. **Numerical differentiations:** Newton's forward and backward formulae to compute the derivatives; Derivative using Stirlings formulae. **Numerical integration :** Newton Cote's formula;

Trapezoidal rule; Simpson's 1/3rd and 3/8th rules; Weddle's rule; Gaussian quadrature; Estimation of error in each formulae.

Text Books:

1. J. L. Bansal, S. L. Bhargava and S. M. Agarwal, Numerical Analysis, Jaipur Publishing House, Jaipur, 2012.
2. H C Saxena, Finite Differences and Numerical Analysis, S. Chand & Co., New Delhi, 2005.

Reference Books:

1. M K Jain, S R K Iyengar, R K Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 2013.
2. K. Sankara Rao, Numerical Methods for Scientists and Engineers, 2nd Edition, Prentice Hall India, 2004.
3. P. Kandasamy, Numerical Methods, S. Chand & Co., New Delhi, 2007. G. Haribhaskaran, Numerical Methods, Laxmi Publications, Delhi, 2008.

Lecture Plan:

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Numerical analysis: Introduction
3	4	Errors in Numerical computation: Gross error, Round off error, Truncation error; Approximate numbers; Absolute, relative and percentage error.
2	6	Operators: Δ , ∇ , E , μ , δ (Definitions and simple relations among them).
1	7	Class Test-I
3	11	Finite differences: Differences; Operators; Forward and backward difference tables;
3	14	Factorial polynomial; Error propagation in difference table.
1	15	Class Test-II
4	19	Interpolation (for equal intervals): Newton's forward and backward formulae equidistant terms with one or more missing values.
5	24	Central differences and central differences table; Gauss forward and backward formulae.
4	28	Stirlings and Bessel formula.
1	29	Class Test-III
3	32	Interpolation (for unequal intervals): Divided differences; Properties; Relations between divided differences and forward differences.

2	34	Newton's divided differences formula; Lagrange's formula and inverse interpolation.
1	35	Class test-IV
4	39	Numerical differentiations: Newton's forward and backward formulae to compute the derivatives; Derivative using Stirlings formulae.
1	40	Class Test-V
4	44	Numerical integration: Newton Cote's formula; Trapezoidal rule.
5	49	Simpson's 1/3rd and 3/8th rules; Weddle's rule; Gaussian quadrature; Estimation of error in each formulae.
1	50	Class Test-VI

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 1310.1	An ability to solve numerical methods for finding the real roots of algebraic and transcendental equation. which provides us with a technique to find an approximate but accurate solutions to a mathematical problem.	3										
MA 1310.2	A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations , which involve less amount of labour and best suited for computer operations.		2	2								
MA 1310.3	An ability to solve eigenvalue problems using numerical methods.				2	2						
MA 1310.4	An understanding for finding the numerical solution of ordinary differential equation.						2					
MA 1310.5	A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.			1				1				

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

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 1310.1	An ability to solve numerical methods for finding the real roots of algebraic and transcendental equation. which provides us with a technique to find an approximate but accurate solutions to a mathematical problem.	3										
MA 1310.2	A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations , which involve less amount of labour and best suited for computer operations.		2	2								
MA 1310.3	An ability to solve eigenvalue problems using numerical methods.				2	2						
MA 1310.4	An understanding for finding the numerical solution of ordinary differential equation.						2					
MA 1310.5	A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.			1				1				

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

DISTRIBUTION THEORY | MS1304 | 3 Credits | 2 1 0 3

Session: Aug. 16 – Dec.16 | Faculty: **Dr. Monika Saini** | Class: B.Sc. /B.A. III Sem.

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.

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.

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

Assessment Plan:-

Criteria	Description	Maximum Marks
	Sessional Exam I (Close Book)	20

Internal Assessment (Summative)	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.	

SYLLABUS:-

Discrete Probability Distributions: Bernoulli distribution, Binomial distributions, Poisson distribution, Poisson distribution as a limiting case of Binomial distribution, Negative Binomial 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..

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.

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.

Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Discrete Probability Distributions: Bernoulli distribution-Definition, Probability Mass function, Properties, Numerical.
3	4	Binominal distributions- Definition, Probability Mass function, Properties, Numerical.
3	7	Poisson distribution-- Definition, Probability Mass function, Properties, Numerical. Poisson distribution as a limiting case of Binomial distribution.
2	9	Negative Binominal distribution- Definition, Probability Mass function, Properties, Numerical.
2	11	Geometric distribution- Definition, Probability Mass function, Properties, Numerical. Memory less property.
2	13	Hyper-geometric- Definition, Probability Mass function, Properties, Numerical.
1	14	Continuous Probability Distribution: Uniform distribution- Definition, Probability density function, Properties, Numerical.
3	17	Normal distribution Definition, Probability density function, Properties, Numerical.
3	20	Exponential distribution -Definition, Probability density function, Properties, Numerical. Memory less property.
2	22	Gamma distribution -Definition, Probability density function, Properties, Numerical.
2	24	Beta distribution- Definition, Probability density function, Properties, Numerical.
1	25	Cauchy distribution -Definition, Probability density function, Properties, Numerical.
3	28	Limit Laws: Convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution,
2	30	Weak law of large numbers (WLLN)
2	32	Strong law of large numbers (SLLN)
4	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.

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
MS1304.1	Understand the concept of probability Distributions	2			2			3				
MS1304.2	Understand conceptual framework of discrete probability distributions and their implementation.		2	3		2						
MS1304.3	Understand conceptual framework of continuous probability distributions and their implementation.	2		3			1					
MS1304.4	Understand conceptual framework of limit theorems		3		2			3				

5-

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

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
MS1304.1	Understand the concept of probability Distributions											
MS1304.2	Understand conceptual framework of discrete probability distributions and their implementation.											
MS1304.3	Understand conceptual framework of continuous probability distributions and their implementation.											
MS1304.4	Understand conceptual framework of limit theorems											

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

Abstract Algebra | MA1314 | 4 Credits | 3 | 0 4

Session: July 16 – Dec 16 | Faculty: Dr. Bhoopendra Pachauri | Class: Compulsory

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. Abstract algebra is also an ideal capstone course for those who will go on to take postgraduate courses in mathematics. High school teachers should be very skillful at arithmetic, abstract algebra is the course where they learn this very well.

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

- [1314.1] Develop their abstract thinking skills.
- [1314.2] Provide precise definitions and appropriate examples, counter examples of fundamental concepts in Group Ring and field.
- [1314.3] Master the standard computations of group and ring theory.
- [1314.4] Learn the elementary theorems and proof techniques of group and ring theory.
- [1314.5] Apply the theorems, proof techniques and standard computations of group and ring theory to solve the problems.

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

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.	

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; Isomorphism of groups; 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; Normalizer of an element of a group; Class equation of a group; Center of a group; Conjugate subgroups; Invariant subgroups; Quotient groups; 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.

Ring theory: Ring definition; Elementary properties of a ring; Ring with or without zero divisors; Integral domain; Field; Division ring or skew field; Isomorphism of rings; Subrings; Subfields; Characteristic of a ring; Ordered integral domains; The field of quotients; Ideals; Principal ideal; Principal ideal ring; Divisibility in an integral domain; Polynomial rings; Polynomials over an integral domain; Division algorithm for polynomials over a field; Euclidean algorithm for polynomials over a field; Unique factorization domain; Unique factorization theorem for polynomials over a field; Remainder theorem; Prime fields; Rings of endomorphisms of an abelian group; Quotient rings or residue class rings; Homomorphism of rings; Kernel of a ring homomorphism; Maximal ideals, Prime ideals; Euclidean rings or Euclidean domains.

TEXT BOOKS

T1. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, 2nd Edition, Cambridge University Press, 1997.

T2. N. S. Gopalakrishanan, University Algebra, New Age International (P) Ltd., 2004.

REFERENCE BOOKS

R1. H. S. Hall and S. R. Knight, Higher Algebra, H. M. Publications, 1994.

R2. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2013.

R3. J. A. Gallian Contemporary Abstract Algebra, Cengage learning, 2013.

Lecture Plan:

LEC NO	TOPICS
1	Introduction
2	Binary operation on a set, Algebraic structure,
3	Definition of a group, Abelian group
4	Finite and infinite groups, Order of a group
5	Properties of groups
6	Addition modulo m ; Multiplication modulo p
7	Residue classes of the set of integers
8	Permutations; Groups of permutations
9	Cyclic permutation
10	Even and odd permutations
11	Integral powers of an element of a group;
12	Order of an element of a group;
13	Isomorphism of groups; Subgroups;
14	Intersection of subgroups; Cosets;
15	Lagrange's theorem; Euler's theorem
16	Fermat's theorem
17	Order of the product of two subgroups of finite order; Cayley's theorem;
18	Cyclic groups; Subgroup generated by a subset of a group;
19	Generating system of group
20	Normal subgroups
21	Conjugate elements
22	Normalizer of an element of a group; Class equation of a group
23	Center of a group; Conjugate subgroups
24	Invariant subgroups
25	Quotient groups
26	Homomorphism of groups; Kernel of a homomorphism
27,28	Fundamental theorems on homomorphism of groups
29	Auto morphisms of a group
30	Inner auto morphisms; Results on group homomorphism;
31	Maximal subgroups
32	Ring definition
33	Elementary properties of a ring;
34	Ring with or without zero divisors
35	Integral domain
36	Field
37	Division ring or skew field
38	Isomorphism of rings;
39	Subrings
40	Subfields; Characteristic of a ring;
41	Ordered integral domains; The field of quotients
42	Ideals; Principal ideal;
43	Principal ideal ring
44	Divisibility in an integral domain; Polynomial rings;
45	Polynomials over an integral domain; Division algorithm for polynomials over a field;
46	Euclidean algorithm for polynomials over a field;
47	Unique factorization domain;
48	Unique factorization theorem for polynomials over a field; Remainder theorem;
49	Prime fields; Rings of endomorphism's of an abelian group;
50	Quotient rings or residue class rings; Homomorphism of rings;
51	Kernel of a ring homomorphism;Maximal ideals
52	Prime ideals; Euclidean rings or Euclidean domains

	concepts in Group Ring and field.											
MA1314.3	Master the standard computations of group and ring theory.			2	2							
MA1314.4	Learn the elementary theorems and proof techniques of group and ring theory.					2						
MA1314.5	Apply the theorems, proof techniques and standard computations of group and ring theory to solve the problems.			1								

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

Real Analysis I | MA1315 | 4 Credits | 3 | 0 4

Session: July 2016– Dec 16 | Faculty: Dr. Virendra Singh Chouhan | Class: B.Sc. Hon. (Mathematics) IIIrd sem.

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.

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

- [1315.1] Understand the role of real line in terms of rational, irrational, real numbers etc.
- [1315.2] Use of real line to find the neighbourhood, interior point, open set, limit point, closed set etc.
- [1315.3] Find the convergence and divergence of sequence and series by using different types of tests.
- [1315.4] Find the Limit and continuity of function.
- [1315.5] Apply Mean value theorem.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.8]. Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
- [PO.9]. Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
- [PO.10]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.11]. 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.12]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
- [PO.13]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.14]. 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

Assessment Plan:

Criteria	Description	Maximum Marks
Internal (Summative)	Assessment	
	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.

SYLLABUS

Real numbers: Order properties of \mathbb{Q} and its order incompleteness; Real numbers as a complete ordered field; Supremum and infimum; Archimedean property; Density of rational numbers in \mathbb{R} ; Characterization of intervals; Neighborhoods; Open sets; Closed sets; Limit points of a set; Bolzano-Weierstrass theorem; Isolated points; Closure; Compact set; Heine-Borel theorem; Countability of \mathbb{Z} and \mathbb{Q} ; Uncountability of \mathbb{R} . **Real sequences:** Sequences; Bounded sequences; Monotonic sequences; Convergence of sequences; Limit point of a sequence; Limsup and liminf; Subsequences; Cauchy sequences and their convergence criterion. **Infinite series:** Definition of infinite series; Sequence of partial sums; Convergence of infinite series; Geometric series; Cauchy criterion; Series of non-negative terms; Comparison tests; Cauchy's nth root test; Ratio test; Raabe's test; Cauchy's condensation test; Integral test; Gauss test; Alternating series and Leibnitz's theorem; Absolute and conditional convergence. **Functions of a single variable:** Limit and continuity; Cauchy's & Heine's definition of continuity and their equivalence; Types of discontinuities; Properties of continuous functions on closed interval; Uniform continuity; Derivatives; Darboux's theorem; Rolle's theorem; Mean value theorem.

TEXT BOOKS

1. Shanti Narayan, Elements of Real Analysis, S. Chand & Co., New Delhi, 2013.
2. S. C. Malik and S. Arora, Mathematical Analysis, New Age Int. Pub., New Delhi, 2010.

REFERENCE BOOKS

1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 2000.
2. W. Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw Hill, New York, 2013.
3. H. L. Royden and P. M. Fitzpatrick, Real Analysis, 3rd Edition, Macmillan, New York, 2010.
4. T. M. Apostol, Mathematical Analysis, Addison-Wesley, 2008.

Lecture Plan:

LEC NO	TOPICS
1	Introduction about the subject
2	Real numbers
3	Order properties of \mathbb{Q} and its order incompleteness
4	Real numbers as a complete ordered field
5,6	Supremum and infimum, Archimedean property
7,8	Density of rational numbers in \mathbb{R} , Characterization of intervals
9	Neighborhoods; Open sets, Closed sets
10	Limit points of a set, Bolzano-Weierstrass theorem

11,12	Isolated points; Closure;
13,14	Compact set; Heine-Borel theorem
15	Countability of \mathbb{Z} and \mathbb{Q} ; Uncountability of \mathbb{R} .
16,17	Sequences; Bounded sequences; Monotonic sequences
18,19	Convergence of sequences; Limit point of a sequence
20,21	Limsup and liminf
22	Subsequences;
23,24	Cauchy sequences and their convergence criterion
25,26	Definition of infinite series
27,28	Sequence of partial sums; Convergence of infinite series
29, 30	Geometric series, Cauchy criterion
31,32	Series of non-negative terms; Comparison tests
33	Cauchy's nth root test
34	Ratio test, Raabe's test
35,36	Cauchy's condensation test; Integral test
37,38	Gauss test
39	Alternating series and Leibnitz's theorem
40	Absolute and conditional convergence
41	Limit and continuity
42	Cauchy's & Heine's definition of continuity and their equivalence
43	Types of discontinuities
44	Properties of continuous functions on closed interval
45	Uniform continuity
44	Derivatives
47	Darboux's theorem, Rolle's theorem
48	Mean value theorem.

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
MA1315.1	Understand the role of real line in terms of rational, irrational, real numbers etc.	3		2	1							
MA1315.1	Use of real line to find the neighbourhood, interior point, open set, limit point, closed set etc.	2	2				3					
MA1315.1	Find the convergence and divergence of sequence and series by using different types of tests.		2			3		1				

MA1315.1	Find the Limit and continuity of function.			3				2				
MA1315.1	Apply Mean value theorem.			2	3		2					

7-

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

K. 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
MA1315.1	Understand the role of real line in terms of rational, irrational, real numbers etc.											
MA1315.1	Use of real line to find the neighbourhood, interior point, open set, limit point, closed set etc.											
MA1315.1	Find the convergence and divergence of sequence and series by using different types of tests.											
MA1315.1	Find the Limit and continuity of function.											
MA1315.1	Apply Mean value theorem.											

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

SAMPLING THEORY | MS1305 | 3 Credits | 2 1 0 3

Session: Aug. 16 – Dec.16 | Faculty: **Dr. Ashish Kumar** | Class: B.Sc. /B.A. III Sem.

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.

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

- 1305.1** Understand the concept of sample and population.
- 1305.2** Understand conceptual framework of simple random sampling and its implementation.
- 1305.3** Understand conceptual framework of stratified sampling and its implementation.
- 1305.4** Understand conceptual framework of systematic sampling and its implementation.
- 1305.5** Understand conceptual framework of cluster sampling, two-stage sampling and their implementation.

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

Assessment Plan:-

Criteria	Description	Maximum Marks
	Sessional Exam I (Close Book)	20

Internal Assessment (Summative)	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.	

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.

Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Introduction: Concept of population and sample, need for sampling, complete enumeration versus sampling.
2	3	Basic concepts in sampling, sampling and non-sampling errors.
2	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.
1	6	Class Test-I
3	9	Simple Random Sampling with replacement: Estimation of mean, total, variance, proportion, equivalence of different definitions, sample size problem.
3	12	Simple Random Sampling without replacement: Estimation of mean, total, variance, proportion, equivalence of different definitions, sample size problem.
1	13	Class Test-II
3	16	Stratified Sampling: Estimation of mean, total, proportion and optimum allocation.
2	18	Comparison with simple random sampling without replacement.
1	19	Post stratification.
1	20	Class test-III
3	17	Systematic Sampling Scheme: Linear and circular systematic sampling..
3	23	Comparison with SRS and stratified sampling schemes, linear trend, simple method of variance
1	24	Class Test-IV
4	28	Cluster Sampling: Estimation of mean and total, relative efficiency and its estimation.
4	32	Optimum unit of sampling and multipurpose surveys, result on equal and unequal clusters.
1	33	Class Test-V
4	37	Two Stage Sampling: results on equal and unequal fsu, allocation of sample.
3	40	Comparison with one stage sampling, effect of change in size of fsu.
1	41	Class Test-VI
1	42	Problem Discussion & Revision



MANIPAL UNIVERSITY JAIPUR
School of Computing and Information Technology

Department of Mathematics and Statistics
Course Hand-out

Linear Algebra| MA 1413 | 4 Credits | 3 | 0 4

Session: January 17 – May 17 | Faculty: Dr Dasari Nagaraju | Class: Regular

Introduction: This course is offered by Dept. of Mathematics & Statistics as a regular course, targeting students who wish to pursue B.Sc. (Hons) Mathematics. It offers in depth knowledge of Matrices, vector spaces, linear independence and dependence nature of vectors, linear span, rank of a matrix, eigen values and eigen vectors of a square matrices, linear transformations. Students are expected to have background knowledge on basic algebraic structures and a knowledge of school level mathematics.

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

- [1413.1]. Understand the basic ideas of vector algebra: linear dependence and independence and spanning
- [1413.2]. Apply the basic techniques of matrix algebra, including finding the inverse of an invertible matrix using Gauss-Jordan elimination
- [1413.3]. Familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix, and to understand the relationship of these concepts to associated systems of linear equations
- [1413.4]. Find the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial and will know how to diagonalize a matrix when this is possible
- [1413.5]. Familiar with the notion of a linear transformation and its matrix

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

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.	

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 (both homogeneous and non-homogeneous) equations; 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

TEXT BOOKS

1. K. B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2000.
2. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, First course in Linear Algebra, Wiley Eastern, New Delhi, 1983.

REFERENCE BOOKS

1. S. Kumaresan, Linear Algebra-A geometric approach, Prentice Hall of India, 2000.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice Hall, Englewood Cliffs, New Jersey, 2014.
3. R. B. Dash and D. K. Dalai, Fundamentals of Linear Algebra, Himalaya Publishing house, 2008.

Lecture Plan:

Lecture No	Topic
1, 2, 3	Matrices: Symmetric; Skew symmetric matrices; Hermitian and skew Hermitian matrices; Row and column matrices; Elementary operations on matrices
4	Rank of a matrix
5, 6	Eigen values, Eigen vectors
7, 8	characteristic equation of a matrix; Cayley Hamilton theorem and its application in finding inverse of a matrix;
9, 10	Applications of matrices to a system of linear (both homogeneous and non-homogeneous) equations
11, 12	Theorems on consistency of a system of linear equations
13	Vector spaces
14, 15	Subspaces; Linear dependence; Independence
16, 17, 18	Linear span and basis; Dimension of a vector space, theorems and problems based on this concept
19, 20	Linear transformations: definition; Some results on linear operator
21	Different types of transformations
22, 23	Rank and nullity; Singular and non-singular transformations;
24	Inverse linear transformation
25, 26	Isomorphism between vector spaces; Linear mapping; Composition of linear maps
27	Representation of transformations by matrices: Introduction
28, 29	Determination of linear transformation for a given matrix and bases
30, 31	Matrix identity and zero transformations; Linear operations on $M_m \times n$
32, 33	Matrix of the composition of linear transformations
34	Polynomials of a linear transformation;
35, 36	Rank and nullity of matrix; Range of a matrix; Kernel of a matrix; Matrix of change of basis
37-48	One tutorial class after every 3 lectures

	dependence and independence and spanning											
MA1413.2	Apply the basic techniques of matrix algebra, including finding the inverse of an invertible matrix using Gauss-Jordan elimination											
MA1413.3	Familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix, and to understand the relationship of these concepts to associated systems of linear equations											
MA1413.4	Find the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial and will know how to diagonalize a matrix when this is possible											
MA1413.5	Familiar with the notion of a linear transformation and its matrix											
MA1413.1	Understand the basic ideas of vector algebra: linear dependence and independence and spanning											

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

Real Analysis II | MA1414 | 4 Credits | 3 | 0 | 4

Session: Jan 17 – May 17 | Faculty: Dr. Virendra Singh Chouhan | Class: B.Sc. Hon. (Mathematics) IV sem.

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 like Riemann integral, Improper integrals, Uniform convergence, Fourier series, Power series, Metric spaces.

The course will develop specialized techniques in problem solving.

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

- [1414.1] find the value of an integral within the concept of Riemann sum for a Function on a given interval.
- [1414.2] perform basic mathematical operations with integration to find out the convergence of improper Integral.
- [1414.3] find the convergence of sequence and series of functions in terms of uniform convergence.
- [1414.4] express a function in infinite series of trigonometric function when function may have finite discontinuity.
- [1414.5] understand all concept of real analysis define on real line in Metric space.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.15]. Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
- [PO.16]. Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
- [PO.17]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.18]. 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.19]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
- [PO.20]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.21]. 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

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.	

SYLLABUS

Riemann integral: Definition and existence; Darboux's theorem; Riemann integral as the limit of a sum; Condition of integrability; Some integrable functions; The fundamental theorem of integral calculus; First and second mean value theorems.

Improper integrals: Convergence of improper integral; Convergence tests; Convergence of beta and gamma functions.

Uniform convergence: Sequence and series of functions; Pointwise and uniform convergence; Tests for uniform convergence; Uniform convergence and continuity; Uniform convergence and integration; Uniform convergence and differentiation.

Fourier series: Definition and examples; Dirichlet's conditions; Change of interval; Fourier series for even and odd functions; Half range series. **Power series:** Radius of convergence; Uniform and absolute convergence; Abel's theorem (without proof).

Metric spaces: Definition and examples; Bounded and unbounded metric spaces; Open spheres and closed spheres; Neighborhood of a point; Open sets; Interior points; Limit points; Closed sets and closure of a set; Boundary points; Diameter of a set; Subspace of a metric space; Convergent and Cauchy sequences; Complete metric space.

TEXT BOOKS

1. Shanti Narayan, Elements of Real Analysis, S. Chand & Co., New Delhi, 2013.
2. S. C. Malik and S. Arora, Mathematical Analysis, New Age Int. Pub., New Delhi, 2010.

REFERENCE BOOKS

1. W. Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw Hill, New York, 2013.

2. H. L. Royden and P. M. Fitzpatrick, Real Analysis, 3rd Edition, Macmillan, New York, 2010.
3. T. M. Apostol, Mathematical Analysis, Addison-Wesley, 2008.
4. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill, New York, 2007.

Lecture Plan:

LEC NO	TOPICS
1	Introduction about the subject
2	Riemann integral: Definition and existence;
3,4	Darboux's theorem
5	Riemann integral as the limit of a sum
6	Condition of integrability
7,8	Some integrable functions
9	The fundamental theorem of integral calculus
10	First and second mean value theorems
11,12	Introduction of Improper integrals and Properties
13,14	Convergence of improper integral
15,16	Convergence tests
17,18	Convergence of beta and gamma functions
19	Introduction of Uniform convergence
20	Sequence and series of functions
21,22	Point wise and uniform convergence
23,24	Tests for uniform convergence
25,26	Uniform convergence and continuity
27,28	Uniform convergence and integration
29	Definition of Fourier Series and Dirichlet's conditions
30,31	Examples on full range Fourier Series
32,33	Change of interval
34	Fourier series for even and odd functions
35,36	Half range series
37,38	Power series, Radius of convergence
39	Uniform and absolute convergence; Abel's theorem (without proof)
40	Definition and examples of Metric space
41	Bounded and unbounded metric spaces
42,43	Open spheres and closed spheres
44	Neighbourhood of a point; Open sets;
45	Interior points; Limit points
46	Closed sets and closure of a set; Boundary points; Diameter of a set
47	Subspace of a metric space, Convergent and Cauchy sequences
48	Complete metric space.

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
[MA14 14.1]	Find the value of an integral within the concept of Riemann sum for a Function on a given interval.	3			2		1					
[MA14 14.2]	Perform basic mathematical operations with integration to find out the convergence of improper Integral.			2	2	3						
[MA14 14.3]	Find the convergence of sequence and series of functions in terms of uniform convergence.		3			3		1				
[MA14 14.4]	Express a function in infinite series of trigonometric function when function may have finite discontinuity		2		3			2				
[MA14 14.5]	Understand all concept of real analysis define on real line in Metric space.	3		2			3					

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

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
[1414.1]	Find the value of an integral within the concept of Riemann sum for a Function on a given interval.											
[1414.2]	Perform basic mathematical operations with integration to find out the convergence of improper Integral.											
[1414.3]	Find the convergence of sequence and series of functions in terms of uniform convergence.											
[1414.4]	Express a function in infinite series of trigonometric function when function may have finite discontinuity											
[1414.5]	Understand all concept of real analysis define on real line in Metric space.											

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

Vector Calculus and Statics | MA1415 | 4 Credits | 3 | 0 | 4

Session: Jan 17 – May 17 | Faculty: Laxmi Poonia | 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 analyze problems in a systematic and logical manner, including the ability to draw free-body diagrams. Ability to analyze 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

[1415.1] Find the magnitude, direction and component form of displacement vectors.

[1415.2] Perform the following vector operations:

- addition and subtraction,
- scalar multiplication,
- dot product, geometric and component forms,
- cross product, geometric and component forms.

[1415.3] 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.

[1415.4] An ability 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.

[1415.5] 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.

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)	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

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.

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.

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. Apostol, Calculus, Vol. I&II, 2nd Edition, Wiley Students Edition, India, 2012.

Lecture Plan:

LEC NO	TOPICS
1	Introduction and Course Hand-out briefing of Vector algebra
2,3	Addition; Scalar multiplication; Scalar products
4,5	Vector product; Scalar and vector triple products
6,7	Product of four vectors; Reciprocal vectors
7	Geometrical applications
8,9	Vector equations of lines and planes
10,11	Parametric representation of a curve; The circle and other conic sections
12	Notions of a vector function of a single variable
13,14	Vector calculus: Vector differentiation
15	Total differential
16,17	Gradient
18,19	Divergence
20,21	Curl
22,23	Directional derivatives; Laplacian operator.
24	Vector integration: Path, line, surface and volume integrals
25	Line integrals of linear differential forms
26	Integration of total differentials

27,28	Conservative fields; Conditions for line integrals to depend only on the end-points
29	The fundamental theorem on exact differentials
30,31,32,34	Theorems of green, Gauss, Stokes, and problems based on these
35	Introduction to Statics
36	Forces; Couples
37	Co-planar forces
38	A static equilibrium; Friction
39	Equilibrium of a particle on a rough curve
40,41	Virtual work; Catenary
42,43	Forces in three dimensions; Reduction of a system of forces in space
44	Invariance of the system
45	General conditions of equilibrium
46.47	Centre of gravity for different bodies
48	Stable and unstable equilibrium.

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES				
		P O 1	P O 2	P O 3	P O 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 1415.1	Find the magnitude, direction and component form of displacement vectors.	3										
MA14 15.2	Perform the following vector operations: – addition and subtraction, – scalar multiplication, – dot product, geometric and component forms, – cross product, geometric and component forms.		2	2								
MA14 15.3	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						

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

MA 1415.4	An ability 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						
MA14 15.5	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									

Course Outcome Attainment Level Matrix:

CO	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES							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	
MA1415.1	Course Outcome statement	3											
MA1415.2	Course Outcome statement		2	2									
MA1415.3	Course Outcome statement				2	2							
MA1415.4	Course Outcome statement						2						
MA1415.5	Course Outcome statement			1									

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



MANIPAL UNIVERSITY JAIPUR

School of Basic Science

Department of Mathematics and Statistics

Course Hand-out

Linear Programming Problems | MA1416 | 4 Credits | 3 | 0 | 4

Session: Jan. – June 2016 | Faculty: Dr. Mohd. Rizwanullah | Class: B.Sc. (Hons.)-IV Sem.

Introduction:

This course is designed as a foundation course of allocation problem and its application for students in a under graduate program. 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. These "real life" systems can have dozens or hundreds of variables, or more. In algebra, though, we will only work with the simple (and graphable) two-variable linear case.

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

- [1416.1] understand the basic concepts of LPP and its applications,
- [1416.2] understand the characteristics of an optimal solution, concept of convex set and convex combination,
- [1416.3] apply the simplex method for solving linear programming problems,
- [1416.4] formulate the dual problem from primal LPP,
- [1416.5] apply the Hungarian method for solving assignment problems,
- [1416.6] apply different methods to transportation problem to find initial basic feasible solution and optimal solution and also the computational procedure of dual simplex method.

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

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)	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 will be given which has to be submitted within a week from the date of 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.	

SYLLABUS

LPP: Introduction; formulation of an LPP; General form of linear programming problem; Graphical method of solution of LPP; Nature of the solution of an LPP; Areas of application of linear programming. **Characteristic of an optimal solution:** Definitions; Convex combination and convex set; A few important results; Extreme point; Convex hull and convex polyhedron; Standard form of an LPP. **Simplex method:** Fundamental theorem of linear programming; Reduction of a feasible solution to a basic feasible solution; Some definitions and notations; Improving a basic feasible solution; Optimality condition; Unboundedness; Alternative optima; Simplex algorithm; Procedural techniques; Initial basic feasible solution; Simplex tableau; Computational procedure in simplex method; Simplex method for maximization of an LPP standard form; Minimization problem in standard form; Big M method; Two phase method. **Duality:** Concept of duality; Mathematical formulation of duals-construction of duals; Duality theorems; Complementary slackness; Duality and simplex method. **Transportation:** Introduction to transportation problem; Initial basic feasible solution; Moving towards optimality; Degeneracy in transportation problems; Unbalanced transportation problem. **Assignments:** Mathematical formulation of assignment problems; Hungarian method for solving assignment problem; Unbalanced assignment problem; Travelling salesman problem; Formulation of travelling salesman problem as an assignment problem and solution procedure. **Dual simplex method:** Introduction; Dual simplex method; Computational procedure of the dual simplex algorithm; Initial basic solution.

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, Macmillan Pub. India Ltd., 2013.

REFERENCE BOOKS

1. H. A. 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.

Lecture Plan:

Description of the syllabus	No of Hours Allotted	Cumulated lectures
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The Linear programming problem: Basic Concepts	1	1
General form of linear programming problem	1	2
Graphical method of solution of LPP	2	4
Nature of Solution of LPP, Areas of application	1	4
TUTORIAL CLASS – 1	1	6
Characteristics of an optimal solution	1	7
Convex combination and convex set	1	8
Extreme point: Convex hull and convex polyhedron	1	9
TUTORIAL CLASS – 2	1	10
ASSIGNMENT I		
Standard form of Linear Programming Problem, Slack, Surplus and Artificial Variables	1	11
Linear Programming Problem in Matrix notation	1	12
Simplex Method to solve LPP ❖ Concepts, Algorithm	1	13
Numerical Problems	2	15
TUTORIAL CLASS – 3	1	16
Charne's Penalty (Big M) technique: Basic Concept	1	17
Numerical Problems	2	19
Some Exceptional Cases	1	20
TUTORIAL CLASS – 4	1	21
The Two Phase Method: Basic concept & Algorithm	1	22
Numerical Problems	1	23
TUTORIAL CLASS – 5	1	24
ASSIGNMENT II		
Concept of Duality	1	25
Mathematical formulation of duals-construction of duals	1	26
Duality theorem, Complementary slackness	1	27
Duality and simplex method	1	28
Transportation Problems: Concept and Mathematical Modeling	1	29
Solution Algorithm for TP	1	30
Methods to Solve Initial Basic Feasible Solution (IBFS):	1	31
❖ North West Corner Method	1	32
❖ Least Cost Method (LCM)	1	33
❖ Vogel's Approximation Method (VAM)	1	34
TUTORIAL CLASS – 6	1	35
Test for Optimality in Transportation Problem:	1	36
MODI Method: Transportation Algorithm	1	37
Numerical Problem	1	38
Degeneracy and its Resolution	1	39
Maximization Transportation Problem	1	40
TUTORIAL CLASS – 7	1	41
ASSIGNMENT III		
Assignment Problems: Basic Concepts and Mathematical Model	1	42
Solution Method of Assignment Problem	1	43
Method to Solve Assignment Problem: ❖ Hungarian Method: Algorithm	1	44
Numerical Problems	1	45
TUTORIAL CLASS – 8	1	46
Special Case: Maximization, Unbalanced & Restriction Cases	2	48
Dual Simplex Method: Introduction	1	49
Computational procedure and algorithm	1	50
Initial basic solution, numerical problems	2	52
ASSIGNMENT IV		
END SEMESTER EXAMINATION		

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 1416.1	Able to understand the basic concepts of LPP and its applications,			3				2				
MA 1416.2	Able to understand the characteristics of an optimal solution, concept of convex set and convex combination,	1						1				
MA 1416.3	Able to apply the simplex method for solving linear programming problems,	2		2				3				
MA 1416.4	Able to formulate the dual problem from primal LPP,	1						3				
MA 1416.5	apply the Hungarian method for solving assignment problems,	1		3				2				
MA 1416.6	Able to apply different methods to transportation problem to find initial basic feasible solution and optimal solution and also the computational procedure of dual simplex method.	1		3				2				

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

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 1416.1	Able to understand the basic concepts of LPP and its applications,							2	2			
MA 1416.2	Able to understand the characteristics of an optimal solution, concept of convex set and convex combination,	2						3				
MA 1416.3	Able to apply the simplex method for solving linear programming problems,	1						2				
MA 1416.4	Able to formulate the dual problem from primal LPP,							3			2	
MA 1416.5	apply the Hungarian method for solving assignment problems,	3						2	3		2	2
MA 1416.6	Able to apply different methods to transportation problem to find initial basic feasible solution and optimal solution and also the computational procedure of dual simplex method.	3						1	3			3



MANIPAL UNIVERSITY JAIPUR

School of Basic Sciences

Department of Mathematics & Statistics

Course Hand – Out

STATISTICAL INFERENCE: ESTIMATION THEORY | MS1404 | 3 Credits | 2 1 0 3

Session: Jan. 17 – May 17 | Faculty: **Dr. Ashish Kumar** | Class: B.Sc. /B.A. IV Sem.

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.

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

- 1404.1** Understand the concept of statistical inference
- 1404.2** Understand conceptual framework of estimation and estimators
- 1404.3** Understand conceptual framework of estimation procedures and their implementation
- 1404.4** Understand conceptual framework of point estimation.
- 1404.5** Understand the framework of interval estimation

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.

- 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

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.	

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, Bhattacharya’s Bounds, Rao-Blackwell theorem, Lehman Scheffe’s theorem and its applications in finding Uniformly Minimum Variance Unbiased Estimators. **Methods of Estimation:** Method of Maximum Likelihood, Methods of Moments, Minimum chi- square and modified minimum chi- square and their properties. **Interval estimation:** 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, pivotal quantity method of constructing confidence interval, large sample confidence intervals.

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.

Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Estimation: Parametric space, sample space.
3	4	Point Estimation: Properties of good estimator: Consistency, unbiasedness, efficiency, sufficiency.
2	6	Neymann factorization theorem
4	10	Complete sufficient statistics, Minimum – variance unbiased (MVU) estimators, exponential family of distributions and its properties,
3	13	Cramer- Rao inequality, Minimum variance bound (MVB) estimators,
4	17	Bhattacharya's Bounds, Rao-Blackwell theorem, Lehman Schefe's theorem and its applications in finding Uniformly Minimum Variance Unbiased Estimators.
7	24	Methods of Estimation: Method of Maximum Likelihood, Minimum chi- square and modified minimum chi- square and their properties.
7	31	Interval estimation: Confidence intervals for the parameters of various distributions, confidence intervals for difference of means and for ratio of variances,
2	33	confidence interval for binomial proportion
1	34	population correlation coefficient when population is normal,
2	36	pivotal quantity method of constructing confidence interval, large sample confidence intervals.

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
MS1404.1	Understand the concept of statistical inference	2			2			3				

MS1404.2	Understand conceptual framework of estimation and estimators		2	3		2						
MS1404.3	Understand conceptual framework of estimation procedures and their implementation	2		3				1				
MS1404.4	Understand conceptual framework of point estimation		3		2				3			
MS1404.5	Understand the framework of interval estimation	2		2				2				

10-

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

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	
MS1404.1	Understand the concept of statistical inference												
MS1404.2	Understand conceptual framework of estimation and estimators												
MS1404.3	Understand conceptual framework of estimation procedures and their implementation												
MS1404.4	Understand conceptual framework of point estimation												
MS1404.5	Understand the framework of interval estimation												

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

APPLIED STATISTICS | MS1405| 3 Credits | 2 1 0 3

Session: Jan. 17 – May 17 | Faculty: **Dr. Monika Saini** | Class: B.Sc. /B.A. IV Sem.

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.

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

- 1405.1** Understand the concept of demand analysis.
- 1405.2** Understand conceptual framework of Index numbers.
- 1405.3** Understand conceptual framework of time series analysis.
- 1405.4** Understand conceptual framework of statistical Quality Control.

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.

- 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

Assessment Plan:-

Criteria	Description	Maximum Marks
	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20

Internal Assessment (Summative)	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.	

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 data, 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, Laspeyres's, Paasche'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.

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.

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.

Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Demand Analysis: Laws of demand and supply, price and supply elasticity of demand
2	3	partial and cross elasticity of demand, income elasticity of demand, utility function
2	5	methods of determining demand and supply curves from family budget and time series data
2	7	Leontief's method, Pigou's method,
3	10	Engel curve and its different forms, Pareto's law of income distribution, curves of concentration.
2	12	Index Numbers: Introduction and their construction, Laspeyres's, Paasche's, Marshall –Edge Worth and Fisher's index numbers,
2	14	tests for index numbers,
2	16	uses of index numbers, price, quantity and value relatives
2	18	link and chain relatives, chain base index numbers, cost of living index numbers.
2	20	Time Series: Analysis of time series, components of time series,
3	23	trend measurement by mathematical curves, polynomial, growth curves, moving average method, Spencer's formulae,
2	25	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,
3	28	measurement of seasonal fluctuations
2	30	measurement of cyclical component
1	31	periodogram analysis
2	33	Statistical Quality Control: Control charts for variable and attributes.
2	35	acceptance sampling by attributes- single, double, multiple and sequential sampling plans,
2	37	concepts of AOQL and ATI, acceptance sampling by variables-use of Dodge-Romig and other tables.

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
MS1405.1	Understand the concept of demand analysis.	2			2			3				

MS1405.2	Understand conceptual framework of Index numbers.		2	3		2						
MS1405.3	Understand conceptual framework of time series analysis.	2		3			1					
MS1405.4	Understand conceptual framework of statistical Quality Control.		3		2			3				

11-

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

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	
MS1405.1	Understand the concept of demand analysis.												
MS1405.2	Understand conceptual framework of Index numbers.												
MS1405.3	Understand conceptual framework of time series analysis.												
MS1405.4	Understand conceptual framework of statistical Quality Control.												

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



MANIPAL UNIVERSITY JAIPUR

School of Computing and Information Technology

Department of Mathematics & Statistics
Course Hand-out

Discrete Mathematics Structure | MA 1501 | 4 Credits | 3 | 0 | 4

Session: August 17 – December 17 | Faculty: Dr Dasari Nagaraju | Class: Regular

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

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

- [1501.1]. Apply the operations of sets, find the partition for a set through equivalence classes
- [1501.2]. Express a logic sentence in terms of predicates, quantifiers, and logical connectives
- [1501.3]. Demonstrate an understanding of relations and functions and be able to determine their properties and also determine when a function is 1-1 and "onto".
- [1501.4]. Model counting problems using recurrence relations and solve linear recurrence relations by recognizing homogeneity, linearity, constant coefficients, degree, and characteristic equation
- [1501.5]. Solve recurrence relations by using generating functions.

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

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 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 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.	

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.

TEXT BOOKS

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.

Lecture Plan:

Lecture No.	Topic
1	Propositions, atomic, molecular propositions
2, 3	Logical connectives
4, 5	Tautologies and contradictions
6	Converse, inverse and Contrapositive of a proposition
7, 8, 9	Logical equivalences and implications
10, 11, 12	De Morgan's Laws; Normal forms PDNF, PCNF
13, 14, 15	Rules of inference
16	Arguments.
17, 18	Predicates; Statement function; Variables; Quantifiers;
19	Logical equivalences and implications for quantified statements;
20	Validity of arguments
21, 22	Basic concepts; Algebra of sets
23	Types of relations and their properties
24	Relational matrix and the graph of a relation;
25, 26, 27	Partitions; Equivalence relations; Poset; Hasse diagram
28, 29	Functions: Classification; Type of functions; Binary and n-ary operations;
30	Characteristic function of a set, Hashing functions; Recursive functions; Permutation functions;
31	Discrete numeric function and generating functions
32	Recurrence relations and recursive algorithms; Linear recurrence relations with constant coefficients
33, 34	Homogeneous solution; Particular solution; Total solution
35, 36	Solution by the method of generating function
37-48	One tutorial class after every 3 lectures

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
MA1501.1	Apply the operations of sets, find the partition for a set through equivalence classes	3		1				2	3	2	3
MA1501.2	Express a logic sentence in terms of predicates, quantifiers, and logical connectives	3		2			1	2	3	3	3
MA1501.3	Demonstrate an understanding of relations and functions and be able to determine their properties and also determine when a function is 1-1 and "onto".	3		1				2	3	3	3
MA1501.4	Model counting problems using recurrence relations and solve	3					1	2	2	2	2

MA1501.5	Solve recurrence relations by using generating functions.												
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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

Operations Research-I MA 1650 | 4 Credits | 3 | 0 | 4

Session: Jul 17 – Dec 17 | Faculty: Dr. Anamika Jain | Class: B.Sc V Sem (Maths Hons.)

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.

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

- [1650.1] Identify and develop Queueing models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems.
- [1650.2] Understand the applications of, basic methods, and challenges in game theory.
- [1650.3] Understand and facility with 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.
- [1650.4] Identify the design, implementation, and analysis of computational experiments.

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

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 (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.	

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.

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.

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.

Lecture Plan:

LEC NO	TOPICS	Session Objective	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Introduction: Markovian models	To acquaint and clear teachers expectations and understand student expectations	Lecture		NA
2,3	M/M/1 model	Recall real life applications in Markoveian Model and explain the numerical solution of M/M/1 model	Lecture	[1650.1].	In Class Quiz (Not Accounted)
4,5	M/M/1 related problems	Explain real life problems in M/M/1 model	Flipped Classroom		In Class Quiz
6,7	M/M/C (Finite capacity)	Recall real life applications in Markoveian Model and explain the numerical solution of M/M/C model describe their formation and scope	Lecture		Home Assignment
8,9,10	M/M/C related problems	Explain real life problems in M/M/C model formation of the method on operating parameters	Lecture		In Class Quiz
11,12,13	M/M/C (infinite capacity)	Recall real life applications in Markoveian Model and explain the numerical solution of M/M/C model describe their formation and scope	Lecture		Class Quiz
14,15	M/M/C related problems	Explain real life problems in M/M/C model formation of the method on operating parameters	Flipped Classroom		Class Quiz
16,17	M/M/ ∞ queues (Finite source model)	Explain real life applications in Markoveian Model with infinite servers and explain the numerical solution of M/M/ ∞ model describe their formation and scope	Flipped Class		Home Assignment Class Quiz
18,19	M/M/ ∞ related problems	Explain real life problems in M/M/ ∞ model formation of the method on operating parameters	Activity (Think Pair Share)		Class Quiz
20,21	M/G/1 queue (Steady state solutions only).	Explain real life applications in Non-Markoveian model formation of the method on operating parameters	Lecture		Class Quiz
22,23	M/G/1 related problems	Recall real life applications in Non-Markoveian Model and explain the numerical solution of M/G/1 model describe their formation and scope	Lecture		Class Quiz
24,25	Game theory: Games and strategies	Analyse and Identify real life problems game theory and describe their formation and scope	Jigsaw	[1650.2].	Class Quiz

26,27	Introduction of two person zero sum games	Examine the problems of two person zero sum games	Lecture, Activity		Class Quiz
28,29	Maximin and minimax principles	Describe Maximin and minimax principles for different operating parameters	Lecture, Activity		Class Quiz
30,31	Games without saddle point	Describe the solution of numerical problems by Games without saddle point	Lecture		Class Quiz
32,33	Mixed strategies	Describe the solution of Mixed strategies problems by game theory	Lecture		Class Quiz
34,35	Solution of 2 x 2 rectangular games	Explain Solution of 2 x 2 rectangular games formation of the method on operating parameters	Lecture		Class Quiz
36,37	Graphical method	Explain graphical solution and formation of the method on operating parameters	Flipped Class		Class Quiz
38,39	Dominance property	Describe Dominance property and interpret the formation of the method on operating parameters	Lecture		Class Quiz
40,41,42	Algebraic method for m x n games	Describe the algebraic method for m x n games and applications	Lecture		Class Quiz
43,44	PERT/CPM: Development	Describe the working process of Wolfe's and Beale's method	Flipped Class	[1650.3].	Class Quiz
45,46	Uses and application of PERT/CPM techniques	Describe the uses and application of PERT/CPM techniques	Flipped Class		Class Quiz
47,48	Network diagram representation	Identify different numerical problems of Network diagram representation and explain there solutions	Lecture		Class Quiz
49,50	Fulkerson I-J rule for labeling time estimate	Examine Fulkerson I-J rule for labeling time estimate problems in real life	Lecture	[1650.4].	Class Quiz
51,52	Determination of critical path on network analysis	Describe determination of critical path on network analysis and interpret the formation of the method on operating parameters	Lecture		Class Quiz
53	PERT techniques	Explain computational problems in PERT techniques	Flipped Classroom		Class Quiz
54	Crashing	Explain and summarization to properties and application of the operations research and some related problems of Crashing	Flipped Classroom		Class Quiz

Course Articulation Matrix: (Mapping of COs with POs)

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	PSO 1	PSO 2	PSO 3	PSO 4
MA 165 0.1	Identify and develop Queueing models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems.	3								2	2	
MA 165 0.2	Understand the applications of, basic methods, and challenges in game theory.		2	2					2	2	1	
MA 165 0.3	Understand and facility with 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			2	2		
MA 165 0.4	Identify the design, implementation, and analysis of computational experiments.						2	2		2	2	1

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

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 1650.1	Identify and develop Queueing models from the verbal description of the real system. Understand the mathematical tools that are needed to solve optimization problems.	3								2	2	
MA 1650.2	Understand the applications of, basic methods, and challenges in game theory.		2	2					2	2	1	

MA 1650.3	Understand and facility with 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			2	2		
MA 1650.4	Identify the design, implementation, and analysis of computational experiments.						2	2		2	2	1

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

Dynamics | MA1503 | 4 Credits | 3 1 0 4

Session: July. 17 – Dec. 17 | Faculty: **Dr. Sunil Joshi** | Class: B. Sc.(Hon) Maths V Sem.

Introduction:-

Mechanics is divided in two parts, Kinematics and Kinematics. We have looked at position, velocity and acceleration as the three basic properties of a particle in motion. In Dynamics, we look at the *causes* of the motion. In studying these causes, which we shall call forces, we can get a more complete picture of a given physical situation. Starting with a given set of forces, through dynamics we are able to describe all resulting motion. Dynamics is thus the basis for the rest of the study of classical mechanics, and is applied in every branch of physics and engineering.

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

- 1503.1** Be Proficient in the use of mathematical methods to analyse the forces and motion of complex system.
- 1503.2** Be proficient in the use for symbolic calculations.
- 1503.3** Be able to analyse the motion and the dynamical forces acting on mechanical systems.
- 1503.4** Analyze the dynamic force analysis of mechanisms

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

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.	

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.

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

References:

1. J 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

B. Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Introductory part of the Dynamics.
2	3	Radial, Transverse velocity and acceleration with problems

1	6	tangential, normal velocities and accelerations and problems
2	7	Tutorial Class-I
		Assignment-I
2	9	Introduction to simple harmonic motion and related problems
1	11	Repulsion from a fixed pint and problems
2	13	Motion under inverse square Law and problems
1	14	Tutorial Class-II
1	16	Hooke's law, Horizontal and vertical elastic strings
1	18	Problems based on Hooke's law
		Assignment-II
1	19	Tutorial Class-III
		First Sessional
1	21	Motion of a projectile on an inclined plane
2	22	Problems based on Projectile motion
3	25	Work energy and impulse and related problems
4	26	Tutorial Class-IV
		Assignment-III
1	28	uniform circular motion and problems
2	30	motion on a smooth curve in a vertical plane
3	32	Cycloidal motion and problems
		Assignment-IV
1	33	Tutorial Class-V
2	37	Motion in the resisting medium: Resistance varies as velocity and acquire of velocity.
3	39	Central forces
4	40	Tutorial Class-VI
		Second Sessional
1	42	Stability of nearly circular orbits and problems
2	43	Kepler's laws
3	44	Tutorial Class-VII
4	46	Time of describing an arc and area of any orbit and related problem
5	48	Motion of a particle on a smooth curve and problems
6	50	Principle of conservation of energy and applications
		Assignment-V

C. 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
MA1503.1	Be Proficient in the use of mathematical methods to analyse the forces and motion of complex system.	2			2			3				
MA1503.2	Be proficient in the use for symbolic calculations.		2	3		2						
MA1503.3	Be able to analyse the motion and the dynamical forces acting on mechanical systems.	2		3			1					
MA1503.4	Analyze the dynamic force analysis of mechanisms		3		2			3				

14-

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

D. 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
MA1503.1	Be Proficient in the use of mathematical methods to analyse the forces and motion of complex system.											
MA1503.2	Be proficient in the use for symbolic calculations.											
MA1503.3	Be able to analyse the motion and the dynamical forces acting on mechanical systems.											
MA1503.4	Analyze the dynamic force analysis of mechanisms											

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

Numerical Methods | MA1504 | 2 Credits |

Session: July 17 – December 17 | Faculty: Ruchika M |



Introduction: The Graduate shall be 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.

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

- [1504.1]. An ability to solve numerical methods for finding the real roots of algebraic and transcendental equation. which provides us with a technique to find an approximate but accurate solutions to a mathematical problem.
- [1504.2]. A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations , which involve less amount of labour and best suited for computer operations.
- [1504.3]. An ability to solve eigenvalue problems using numerical methods.
- [1504.4]. An understanding for finding the numerical solution of ordinary differential equation.
- [1504.5]. A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.

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

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.	

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.

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.

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.

Lecture Plan:

LEC NO	TOPICS
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	Numerical solution of algebraic and transcendental equations:
1	<ul style="list-style-type: none"> • Introduction
2,3	<ul style="list-style-type: none"> • Bisection method
4,5	<ul style="list-style-type: none"> • Regula falsi method
6,7	<ul style="list-style-type: none"> • Secant method
8,9	<ul style="list-style-type: none"> • Iteration method
10,11	<ul style="list-style-type: none"> • Newton-Raphson method
12,13	<ul style="list-style-type: none"> • Convergence of iteration method, Convergence criteria and order of convergence of all above methods
	Solution of simultaneous linear algebraic equations:
14,15	<ul style="list-style-type: none"> • Gauss elimination method
16,17	<ul style="list-style-type: none"> • Gauss Jordan method
18,19	<ul style="list-style-type: none"> • Method of triangularization
20,21	<ul style="list-style-type: none"> • Doolittle's method
22,23	<ul style="list-style-type: none"> • Crout's method
24,25	<ul style="list-style-type: none"> • Cholesky method
26,27	<ul style="list-style-type: none"> • Gauss Jacobi method
28,29	<ul style="list-style-type: none"> • Gauss Seidel method
	Eigenvalue problems:
30,31,32,33	<ul style="list-style-type: none"> • Power method for numerically extreme eigenvalues and the inverse power methods
	Numerical solution of O.D.E. (for first order only):
34,35	<ul style="list-style-type: none"> • Picard's method
36,37	<ul style="list-style-type: none"> • Euler's method
38,39	<ul style="list-style-type: none"> • Modified Euler method
40,41	<ul style="list-style-type: none"> • Taylor series method
42,43	<ul style="list-style-type: none"> • Milne's predictor corrector formulae
44,45	<ul style="list-style-type: none"> • Runge Kutta methods (upto fourth order)
	Solution of ordinary differential equations by finite difference method (for second order O.D.E)
46,47,48	<ul style="list-style-type: none"> • Finite difference approximations of the derivatives.

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	An ability to solve numerical methods for finding the real roots of algebraic and transcendental equation. which provides us with a technique to find an approximate but accurate solutions to a mathematical problem.	3										
MA 1504.2	A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations , which involve less amount of labour and best suited for computer operations.		2	2								
MA 1504.3	An ability to solve eigenvalue problems using numerical methods.				2	2						
MA 1504.4	An understanding for finding the numerical solution of ordinary differential equation.						2					
MA 1504.5	A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.			1				1				

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

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 1504.1	An ability to solve numerical methods for finding the real roots of algebraic and transcendental equation. which provides us with a technique to find an approximate but accurate solutions to a mathematical problem.	3										
MA 1504.2	A knowledge of understanding of numerical methods for Solution of simultaneous linear algebraic equations , which involve less amount of labour and best suited for computer operations.		2	2								
MA 1504.3	An ability to solve eigenvalue problems using numerical methods.				2	2						

MA 1504.4	An understanding for finding the numerical solution of ordinary differential equation.						2					
MA 1504.5	A knowledge and understanding to find the Solution of ordinary differential equations by finite difference method.			1				1				

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

ECONOMETRICS | MS1505 | 3 Credits | 2 1 0 3

Session: Aug. 17 – Dec.17 | Faculty: **Dr. Ashish Kumar** | Class: B.Sc. /B.A. V Sem.

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.

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

- 1505.1** Understand the concept of bivariate data to find the relation between variables
- 1505.2** Understand conceptual of predication of dependent variable
- 1505.3** Understand conceptual framework of simple linear regression models.
- 1505.4** Understand conceptual framework of OLS estimation.
- 1505.5** Understand the conceptual framework of autocorrelation

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

Assessment Plan:-

Criteria	Description	Maximum Marks
	Sessional Exam I (Close Book)	20
	Sessional Exam II (Close Book)	20

Internal Assessment (Summative)	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.	

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 heteroscedasticity. **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.

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.

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.

Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
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1	1	Bivariate Data: Scatter diagram, correlation and their uses
2	3	product moment correlation coefficient and rank correlation
2	5	multiple correlation in case of three variables.
2	7	partial correlation in case of three variables.
4	11	Regression Analysis
1	12	Introduction: Definition and scope of econometrics, methodology of econometric research.
3	15	Simple Linear Regression Model: Assumptions, estimation (through OLS method), desirable properties of estimators
2	17	Gauss- Markov theorem,
4	21	interpretation of regression coefficients, testing of regression coefficients, test for regression as a whole,
2	23	coefficient of determination.
2	25	Problems in OLS Estimation: Problems of heteroscedasticity.
3	28	Autocorrelation: concept, consequences of autocorrelated disturbances
2	30	detection of autocorrelation, their estimation and testing,
2	32	Estimation using Durbin-Watson statistic
4	36	Forecasting, exponential smoothing for linear trend model.

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	Understand the concept of bivariate data to find the relation between variables	2			2			3				
MS1505.2	Understand conceptual of predication of dependent variable.		2	3		2						
MS1505.3	Understand conceptual framework of simple linear regression models.	2		3			1					
MS1505.4	Understand conceptual framework of OLS estimation		3		2			3				
MS1505.5	Understand the conceptual framework of autocorrelation	2		2			2					

15-

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

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
MS1505.1	Understand the concept of bivariate data to find the relation between variables											
MS1505.2	Understand conceptual of predication of dependent variable.											
MS1505.3	Understand conceptual framework of simple linear regression models.											
MS1505.4	Understand conceptual framework of OLS estimation											
MS1505.5	Understand the conceptual framework of autocorrelation											

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

STATISTICAL INFERENCE: TESTING OF HYPOTHESIS | MS1506| 3 Credits | 2 1 0 3

Session: Aug. 17 – Dec.17 | Faculty: **Dr. Monika Saini** | Class: B.Sc. /B.A. V Sem.

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

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

- 1505.1** Understand the concept of statistical decision theory
- 1505.2** Understand conceptual framework of likelihood tests
- 1505.3** Understand conceptual framework of sampling distributions and their implementation
- 1505.4** Understand conceptual framework of tests of significance.
- 1505.5** Understand the framework of non-parametric test for analysis of data

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

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.	

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.

Lecture Plan:-

Lecture No.	Cumulative Lecture	Description of the syllabus
1	1	Elements of Statistical Decision Theory: Neymann theory of testing of hypotheses
2	3	simple and composite hypotheses, null and alternative hypotheses, two types of errors, critical region, level of significance
3	6	power of the test, unbiased tests, N-P lemma, construction of most powerful test, uniformly most powerful test, uniformly most powerful unbiased test.
3	9	Likelihood Ratio Test: Likelihood ratio test and its applications,
3	12	asymptotic distribution of LR statistic and asymptotic power of LR tests
2	14	Sampling Distributions: Chi-square distribution and their applications.
2	16	Student's t distribution and their applications.
2	18	Seducer's F distribution and their applications.
2	20	Fisher's-Z distribution and their applications.

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 analysis of data												

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