COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester I			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
								Theory			**Practical**		**Total**	
			L	**T**	**P**	**C**	**Hrs/Wk**	**MS**	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**	
1.	20BSM101T	Calculus - I (Group A)	3	0	0	3	3	25	50	25	--	--	100	
2.	20BSM102T	Basic Mathematics -I (Group B)	3	0	0	3	3	25	50	25	--	--	100	
	BSP101	University Physics – I	3	0	0	3	3	25	50	25	--	--	100	
	BSP101P	University Physics – I Lab	0	0	2	1	2	--	--	--	50	50	100	
	BSC101	Chemistry – I	3	0	0	3	3	25	50	25	--	--	100	
	BSC101P	Chemistry – I Lab	0	0	2	1	2	--	--	--	50	50	100	
	A111	Foreign Language	3	0	0	3	3	25	50	25	--	--	100	
	A101	English Communication	3	0	0	3	3	25	50	25	--	--	100	
		Elective 1	3	0	0	3	3	25	50	25	--	--	100	
Total			**21**	**0**	**4**	**23**	**25**						**900**	

Elective 1	
20BSM103T	Elementary Algebra
A104	Computer Science
A106	Leadership
A107	Understanding Theatrical Arts

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam.

Except Calculus 1, Basic Mathematics 1 and Elementary Algebra are to be floated and taught by other departments.

20BSM101T					Calculus-I (Group A)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To make familiar the students to basic elements of calculus in sufficiently rigorous manner.
- To understand the concept of parametric representation.
- To perform basic operations on vector functions.
- To make aware of use of elementary calculus in curve tracing, finding volume, length of curves, surface area, etc.

UNIT 1 DERIVATIVES OF A FUNCTION **10 Hrs.**

Hyperbolic functions, Higher order derivatives, Applications of Leibnitz rule. The first derivative test, concavity and inflection points, Second derivative test, Curve sketching using first and second derivative test, limits at infinity, and graphs with asymptotes. Graphs with asymptotes, L'Hopital's rule, applications in business, economics and life sciences.

UNIT 2 PARAMETRIC REPRESENTATION OF CURVE **10 Hrs.**

Parametric representation of curves and tracing of parametric curves, Polar coordinates and tracing of curves in polar coordinates. Reduction formulae, derivations and illustrations of reduction formulae of the type.

UNIT 3 APPLICATIONS OF CALCULUS **10 Hrs.**

Volumes by slicing; disks and washers methods, Volumes by cylindrical shells. Arc length, arc length of parametric curves, Area of surface of revolution. Rotation of axes and second degree equations, classification into conics using the discriminant.

UNIT 4 VECTOR FUNCTION **10 Hrs.**

Introduction to vector functions and their graphs, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions. Central force motion, Modeling ballistics and planetary motion, Kepler's second law, Curvature.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Apply calculus to calculate the volume, area etc. of one-dimensional object.
CO2 – Explain the properties of a graph of a function using derivatives.
CO3 – Analyze the applied problems using the concept of derivative.
CO4 – Analyze vector functions to find derivatives, tangent lines, integrals, arc length and curvature.
CO5 – Evaluate the derivative of a function.
CO6 – Evaluate a wide range of problems of mathematical applications using derivative or integral of vector function.

TEXT/REFERENCE BOOKS

1. J. Stewart, Essential Calculus-Early Transcendentals, 8nd ed., Cengage Learning, 2015.
2. H. Anton, I. Bivens and S. Davis, Calculus, John Wiley and sons (Asia), Pvt. Ltd., 7th ed., Singapore, 2002.
3. F. Ayres and E. Mendelson, Schaum's outline of Calculus, 6th ed., McGraw-Hill Education, 2012.
4. T. M. Apostol, Calculus, volume I, 2nd ed., John Wiley and Sons, 1975.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 6 questions of 4 marks each 24 Marks

Part B: 6 questions of 8 marks each 48 Marks

Part C: 2 questions of 14 marks each 28 Marks

20BSM102T					Basic Mathematics - I (Group B)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To make students acquainted with the basics of sets, relation and functions.
- To familiarize the students with concept complex variables.
- To introduce the concept of matrix, determinants and their use to solve systems of equations.
- To learn fundamental differential and integral calculus.
- To demonstrate concepts and visualization of analytical geometry.

UNIT I SETS, RELATIONS, FUNCTIONS AND COMPLEX NUMBERS 10 Hrs.

Sets and their representation. Union, intersection and complement. Mapping or function. One-one, onto mappings. Inverse and composite mappings.

Definition and geometrical representation. Algebra. Complex conjugate. Modulus and amplitude. Polar form. DeMoivre's theorem. Roots of complex numbers. Simple functions.

UNIT II MATRICES AND DETERMINANTS 10 Hrs.

Algebra of matrices. Determinant of a square matrix. Properties of determinants. Some simple type of matrices. Inverse of a matrix. Solution of equations. Intersections. Distance between two points. Shortest distance between lines.

UNIT III DIFFERENTIAL AND INTEGRAL CALCULUS 10 Hrs.

Basic concept of limit and continuity. Derivative. Rules of differentiation. Tangent to a curve. Taylor's series. Maxima and minima. Antiderivative, Fundamental theorem of calculus (statement only). Integrals of elementary functions. Substitution and partial fractions. Definite integral as a limit of sum. Properties of definite integrals. Application to areas and lengths.

UNIT IV TWO DIMENSIONAL COORDINATE GEOMETRY 10 Hrs.

Cartesian coordinate system. Distance between two points. Equation of line in different forms. Equations of circle, ellipse and parabola. Equation of a tangent to a curve. Area of a triangle.

TOTAL 40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Apply set operations.
CO2 – Demonstrate the concepts of complex numbers
CO3 – Analyse the applications of determinants.
CO4 – Demonstrate basic matrix operations.
CO5 – Apply differential and integral calculus.
CO6 – Analyse two dimensional coordinate geometry.

TEXTS AND REFERENCES

1. G. B. Thomas and R.L. Finney, Calculus and analytical geometry, 9th ed., Pearson Education Asia (Adisson Wesley), New Delhi, 2000
2. NCERT, Mathematics Textbook for class XI and XII, 2009.
3. R.D. Sharma, Mathematics, Dhanpat Rai Publications, New Delhi, 2011.
4. M.D. Raisinghania, Ordinary and Partial Differential Equations by, 8th ed., S. Chand Publication, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each 24 Marks
Part B: 6 questions of 8 marks each 48 Marks
Part C: 2 questions of 14 marks each 28 Marks

20BSM103T					Elementary Algebra					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To make familiarize with various number systems.
- To be able to form and solve equations up to degree 4.
- To make students understand the role of scalars and vectors and their applications.
- To acquaint the students with computing inverse of a matrix.

UNIT 1 NUMBER SYSTEMS **09 Hrs.**

Natural numbers, Integers, Rational and Irrational numbers, Real numbers, Complex numbers, Mappings, Equivalence relation and partitions, Congruence modulo n.

UNIT 2 ROOTS OF EQUATIONS **11 Hrs.**

Fundamental Theorem of Algebra, Relations between Roots and Coefficients, transformation of equations, *Descartes rule of signs, Algebraic Solution of a cubic equations (Cardan's method), Bi-quadratic Equations.

UNIT 3 SCALARS AND VECTORS **10 Hrs.**

Introduction to vectors and scalars, Vector addition and subtraction, Scalar multiplication, Magnitude of vectors, Unit vectors, Dot Product, Cross Product, vector triangle inequality, Properties, Application of vectors: pushing a box, tug of war, hiking.

UNIT 4 MATRICES AND DETERMINANTS **10 Hrs.**

Introduction, Matrix notations, Types of matrices- symmetric, skew-symmetric, Hermitian and skew-Hermitian, Matrix Multiplication, elementary operations on matrices, *Determinants- Properties and value of a determinant, adjoint and inverse of a matrix.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Define various number systems and identify the domain of their applications.

CO2 – Classify scalars and vectors and understand their individual role.

CO3 – Apply theory of equations to solve real life problems.

CO4 – Classify various types of matrices and apply elementary operations.

CO5 – Evaluate inverse of a matrix.

CO6 – Formulate a problem and incorporate its solution using an appropriate tool.

TEXT/REFERENCE BOOKS

1. Leonard E. Dickson, First Course in the Theory of Equations, Wentworth Press, 2019.
2. John Bird, Engineering Mathematics, 5th ed., Oxford, 2005.
3. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India, 2002.
4. Aufmann, Barker, and Lockwood, Beginning Algebra with Applications, 6th ed., Houghton Mifflin Company, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

Semester II			B.Sc. (Mathematics)										
Sr. No.	Course/Lab Code	Course/Lab Name	Teaching Scheme					Examination Scheme					
			L	T	P	C	Hrs/Wk	Theory			Practical		Total
								MS	ES	IA	L W	LE/Viva	Marks
1.	20BSM104T	Calculus - II (Group A)	3	0	0	3	3	25	50	25	--	--	100
2.	20BSM105T	Basic Mathematics -II (Group B)	3	0	0	3	3	25	50	25	--	--	100
	16BSP201	University Physics – II	3	0	0	3	3	25	50	25	--	--	100
	16BSC201	Chemistry - II	3	0	0	3	3	25	50	25	--	--	100
	16BSP203T	Elements of Environment Studies	3	0	0	3	3	25	50	25	--	--	100
	16BSP201P	University Physics – II Lab	0	0	2	1	2	--	--	--	50	50	100
	16BSC201P	Chemistry – II Lab	0	0	2	1	2	--	--	--	50	50	100
		Elective 1	3	0	0	3	3	25	50	25	--	--	100
		Elective 2	3	0	0	3	3	25	50	25	--	--	100
		Elective 3	3	0	0	3	3	25	50	25	--	--	100
		Total	**24**	**0**	**4**	**26**	**28**						**1000**

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam.

Elective 1, 2 and 3 except Theory of Equations are to be floated and taught by other departments.

Elective 1 any one foreign language to be selected from the available options		Elective 2		Elective 3	
16A205	French - 1	20BSM106E	Theory of Equation	16A215	Fundamental of Programming and data structure
16A210	Chinese - 1	16BSP202T	Mechanics	16A209	Musical styles
16A211	Japanese - 1	16BSC203E	Introduction to Bio Chemistry	16A217	Overview of Indian art
16A219	French - 2				
16A220	Chinese - 2				
16A221	Japanese - 2				
16A205	French - 1				

20BSM104T					Calculus – II (Group A)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide basic understanding of calculus of several variables.
- To be able to obtain extreme values of multivariate function.
- To study the multiple integration, understand it geometrically and explore its applications.
- To use this basic course in upcoming courses in respective specializations in higher classes.

UNIT 1 FUNCTIONS OF SEVERAL VARIABLES **11 Hrs.**

Functions of several variables, limit and continuity of functions of two variables. Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes.

UNIT 2 EXTREMA AND VECTORS **07 Hrs.**

Extrema of functions of two variables, method of Lagrange multipliers, Definition of vector field, gradient, divergence and curl.

UNIT 3 MULTIPLE INTEGRALS **11 Hrs.**

Double integration over rectangular region, double integration over non rectangular~~nonrectangular~~ region. Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals.

UNIT 4 LINE, SURFACE AND VOLUME INTEGRALS WITH THEIR RELATIONSHIPS **11 Hrs.**

Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path. Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stokes' theorem, The Divergence theorem.

40 Hrs.

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1 – Define Function of several variables along with the concept of its limit, continuity and derivative.

CO2 – Understand the basics of vector calculus.

CO3 – Apply the technique of finding multiple integral and their applications

CO4 – Analyze the applications of line integrals.

CO5 – Evaluate the extreme value of multivariate function.

CO6 – Appraise calculus of several variables and vector calculus to understand various problems of science and engineering.

TEXT/REFERENCE BOOKS:

1. E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus, 1st ed., Springer (SIE), Indian Reprint, 1993.
2. G. B. Thomas, R. L. Finney, Calculus and Analytic Geometry, 9th ed., Addison-Wesley Publishing Company, 1998.
3. M. J. Strauss, G. L. Bradley and K. J. Smith, Calculus, 3rd ed., Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2007.
4. J. Stewart, Essential Calculus-Early Transcendentals – 2nd ed., Cengage Learning, 2013.
5. H. Anton, I. Bivens and S. Davis, Calculus, 7th ed., John Wiley and Sons (Asia), Pvt. Ltd., Singapore, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM105T					Basic Mathematics – II (Group B)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the applications of vectors in real world.
- To be able to solve differential equations.
- To be able to classify the data and can measure the central tendency.
- To study the numerical solution of algebraic and transcendental equations

UNIT 1 VECTOR AND COORDINATE GEOMETRY (3D) **10 Hrs.**

Vectors and their algebra. Simple applications to geometry and mechanics. Unit vectors, vectors i, j and k. Components of a vector. Position vector. Direction cosines and direction ratios. Dot and cross products. Projection of a vector on another. Distance between two points. Equations of a line, plane and sphere. Intersections. Distance between two points. Shortest distance between lines.

UNIT 2 ELEMENTARY DIFFERENTIAL EQUATIONS **10 Hrs.**

Definitions of order, degree, linear, nonlinear, homogeneous and non-homogeneous. Solution of first order equations.

UNIT 3 BASIC STATISTICS **10 Hrs.**

Classification of data. Mean mode, median and standard deviation. Frequency distributions and Measures of Central Tendency.

UNIT 4 BASICS OF NUMERICAL METHODS **10 Hrs.**

Types of errors, Significant figures, Solution of Algebraic and transcendental equations, Bisection method, False-Position method, Iteration method, Newton-Raphson method.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Identify the use of 2D and 3D vectors in daily life.
CO2 – Understand the concept of basic distance formulas in 1D, 2D and 3D and their applications.
CO3 – Explain the types of differential equations and solve according to various categories and shortcut methods.
CO4 – Analyze the supplied data statistically and measure the results according to the requirement.
CO5 – Appraise mathematical problems from real world which contains transcendence nature.
CO6 – Evaluate approximate solutions of linear and nonlinear equations.

TEXT / REFERENCE BOOKS

1. G. B. Thomas and Finney, R. L., Calculus and analytical geometry, 9th ed., Pearson Education Asia, 2000.
2. NCERT**,** Mathematics Textbook for class XI and XII, 2009.
3. Sharma, R.D.**,** Mathematics, Dhanpat Rai Publications, New Delhi, 2011.
4. M. D. Raisinghania, Ordinary and Partial Differential Equations by, 8th ed., S. Chand Publication, 2010.
5. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, 10th edition, S. Chand & Sons Publ., 2000.
6. B. S. Grewal, Higher Engineering Mathematics, 42nd ed., Khanna Publishers, New Delhi, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM106E					Theory of Equations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the students with the fundamental theorem of algebra and it's uses.
- To study the relations between the roots and coefficients of general polynomial equations.
- To study the properties of symmetric functions and derived functions.
- To introduce various methods to solve non-linear equations.

UNIT 1 POLYNOMIAL EQUATIONS **10 Hrs.**

Numerical and algebraic equations, polynomials and their graphical representation, maximum and minimum values of polynomials, fundamental theorem of algebra, theorem on complex roots, theorem on reciprocal roots, theorem on multiple roots.

UNIT 2 RELATION BETWEEN THE ROOTS AND COEFFICIENTS OF A POLYNOMIAL EQUATION **10 Hrs.**

Relation between roots and coefficients of equations, Symmetric functions, Applications symmetric function of the roots, Newton's Theorem on the Sum of the Powers of the Roots, Descarte's rule of signs positive and negative rule.

UNIT 3 ALGEBRAIC SOLUTIONS OF EQUATIONS **10 Hrs.**

Transformation of equations. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic and biquadratic. Properties of the derived functions.

UNIT 4 NUMERICAL SOLUTIONS OF EQUATIONS **10 Hrs.**

Properties of the derived functions, theorem for multiple roots, symmetric functions of the roots.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand and prove fundamental theorems of the subject.
CO2 – Use the relation between roots and coefficients of equations to establish various identities.
CO3 – Solve polynomial equations having conditions on roots.
CO4 – Apply various methods to solve cubic equations (Cardon's method) and biquadratic equations analytically.
CO5 – Solve algebraic and transcendental equations by various numerical methods.
CO6 – Analyze nature of the roots of an equation without explicitly solving the equation.

TEXT/REFERENCE BOOKS

1. Chandrika Prasad : Text Book on Algebra and Theory of Equations. Pothishala Private Ltd., Allahabad
2. W.S. Burnstine and A.W. Panton, Theory of equations, 2007
3. C. C. Mac Duffee, *Theory of Equations*, John Wiley & Sons Inc., 1954.
4. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5thEd., New Age International (2007).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester III			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**	
								MS	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**	
1.	20BSM201T	Analytic Geometry (Group A)	3	1	0	4	4	25	50	25	--	--	100	
2.	20BSM202T	Basic Mathematics -III (Group B)	3	1	0	4	4	25	50	25	--	--	100	
3.	20BSM203T	Ordinary Differential Equations	3	1	0	4	4	25	50	25	--	--	100	
4.	20BSM204T	Analysis - I	3	1	0	4	4	25	50	25	--	--	100	
5.		Elective 1	3	0	0	3	3	25	50	25	--	--	100	
		Elective 2	3	0	0	3	3	25	50	25	--	--	100	
		Total	**18**	**4**	**0**	**22**	**22**						**600**	

Elective 1		Elective 2	
BSP305	Physics Elective-1	A308	Films and Society
BSC305	Chemistry Elective-1	A309	Workplace Communication
20BSM205E	Probability and Statistics	A310	Environmental Psychology
		A311	Atmospheric Sciences
		A312	Indian Government and Politics
		A317	Basics of Accounting
		A318	Introduction to Human Resource Management
		A320	Introduction to Law and Governance

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam.

Except Probability and Statistics subjects from elective 1 and 2 are to be floated and taught by other departments.

20BSM201T					Analytical Geometry (A Group)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To explain the need of different coordinate systems.
- To enable students to visualize three dimensional objects.
- To acquaint the students with the guiding curves of 3D solids.
- To make students understand the basics of central coincidences.

UNIT 1 INTRODUCTION TO 3D GEOMETRY **09 Hrs.**

Line in plane, Line in Space, Circle, Curvilinear coordinates, Spherical and Cylindrical coordinates.

UNIT 2 THE SPHERE **11 Hrs.**

Definition and equation of a sphere, Plane section of a sphere, Intersection of two spheres, Intersection of a sphere and a line, Power of a point, tangent plane, Plane of contact, Polar plane, Pole, Angle of Intersection of two spheres, Radical plane, Co-axial system of spheres.

UNIT 3 CONE AND CYLINDER **10 Hrs.**

Definition and equation of a cone, Vertex , Guiding curve, Generators, Three mutually perpendicular generators, Intersection of a line with a cone, Tangent line and tangent plane, Reciprocal cone, Right circular cone, Definition and equation of a cylinder, Right circular cylinder, Enveloping cylinder.

UNIT 4 CONICOIDS **10 Hrs.**

General equation of second degree, Central conicoids, Tangent plane, Director sphere, Normal, Plane of contact, Polar plane, Conjugate plane and conjugate points.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the role of various coordinate systems in the practical world.

CO2 – Understand the formation of various solids- sphere, cone and cylinder.

CO3 – Apply the concepts of geometry to solids.

CO4 – Distinguish various types of cylinders and explain the significance of each.

CO5 – Appraise the knowledge of calculus to further rate each solid.

CO6 – Construct solids of regular shapes to suit practical needs.

TEXT/REFERENCE BOOKS

1. Shanti Narayan, A Text book of Analytical Geometry, S. Chand, & company, New Delhi.
2. H. Burchared Fine and E. D. Thompson, Coordinate Geometry, The Macmillan Company.
3. P. K. Jain and Khalil Ahmed, A textbook of Analytical Geometry, New Age, Delhi.
4. John Bird, Engineering Mathematics, 5th ed., Oxford, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A : 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM202T					BASIC MATHEMATICS III (B Group)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic concepts of differential calculus.
- To study line integrals and their applications.
- To understand the maxima and minima concepts for the functions of several variable
- To study the vector field and its applications

UNIT I FUNCTIONS OF SEVERAL VARIABLES **8 Hrs.**

Functions from R^n to R^m, scalar vector fields, derivative of a scalar field w.r.t. a vector, directional derivatives and partial derivatives, partial derivatives of higher order, directional derivatives and continuity, the total derivative.

UNIT II VECTOR CALCULUS: **11 Hrs.**

The gradient of a scalar field, a sufficient condition for differentiability, a chain rule for derivatives of scalar fields, applications to geometry, level sets, tangent planes, derivatives of vector fields, Sufficient conditions for the equality of mixed partial derivatives.

UNIT III MAXIMA AND MINIMA OF SEVERAL VARIABLES **9 Hrs.**

Maxima, minima and saddle points, Taylor's formula for scalar fields, Extrema with constraints, Lagrange's multipliers, the extreme value theorem.

UNIT IV LINE INTEGRALS AND ITS APPLICATIONS **12 Hrs.**

Paths and line integrals, Basic properties of line integrals, Line integrals w.r.t. arc length, Applications of line integrals, Open connected sets, Path independence, Fundamental theorems of calculus for line integrals, Applications to Mechanics, Necessary and sufficient conditions for a vector field to be a gradient.

TOTAL **40 Hrs.**

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Apply the functions of several variable concepts

CO2 – Demonstrate the concepts of scalars and vectors.

CO3 – Analyse the concepts of maxima and minima of functions of several variable.

CO4 – Apply the applications of maxima and minima.

CO5 – Analyse the basic concepts of line integrals

CO6 – Demonstrate the applications of line integrals

TEXTS AND REFERENCES

1. T.M. Apostole, Calculus: multi-variable calculus and linear algebra with applications to differential equations and probability, vol 2, 2ed.
2. G. B. Thomas and Ross L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson.
3. R. K. Jain & S. R. K. Iyengar, Higher Engineering Mathematics, 3rd Ed., Narosa (2007).
4. E.Kreyszig,Advanced Engineering Mathematics,8thEd., John Wiley (1999).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM203T					Ordinary Differential Equations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the basic concepts of theory and applications of ordinary differential equations.
- To learn about the formation of differential equations corresponding to a given physical problems.
- To be able to demonstrate comprehension and understanding in the topics of the course through symbols and graphs.
- To learn power series solution method to solve differential equations.
- To be able to model real world problems using differential equations.

UNIT 1 FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS **10 Hrs.**

Definitions of order, degree, linear, nonlinear, homogeneous and non-homogeneous. Solution of first order equations – Variable Separable Form, Linear Differential Equations, Reduction to Linear Differential Equations, Exact Differential Equations, Integrating factors.

UNIT 2 HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS **10 Hrs.**

Higher order linear ordinary differential equations with constant coefficients (homogeneous and non-homogeneous), Complementary function and particular integral, Cauchy-Euler equation, Method of undetermined coefficients, Method of Variation of parameters.

UNIT 3 SERIES SOLUTION OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS **10 Hrs.**

Series solution of Ordinary differential equations, Convergence of series solution, Radius of convergence, Bessel and Legendre's differential equations.

UNIT 4 SYSTEM OF LINEAR ORDINARY DIFFERENTIAL EQUATIONS **10 Hrs.**

System of ordinary differential equations, Solution of initial value problems. Application to solving ordinary differential equations.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand various types of solution methods of solving ordinary differential equations.
CO2 – Demonstrate the series solution for ordinary differential equations about ordinary and singular points.
CO3 – Distinguish between linear, nonlinear, ordinary and partial differential equations with the aid of degree and independent variables.
CO4 – Analyse and evaluate the system of linear ordinary differential equations corresponding to various engineering problems.
CO5 – Develop an ability to formulate differential equations corresponding to a given physical problem.
CO6 – Create mathematical models with the aid of higher order ordinary differential equations to solve engineering problems.

TEXT / REFERENCE BOOKS

1. S.L. Ross, Introduction to Ordinary Differential Equations, Wiley, 4th ed., 1989.
2. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publication, 8th ed., 2010.
3. G.F. Simmons, Differential equations with applications and historical notes, Mc Graw Hill, 2nd ed., 1991.
4. N. Euler, A First Course in Ordinary Differential Equations, Bookboon, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM204T					Analysis-I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the fundamental knowledge of sets, function and bounds
- To be able to understand the convergence and divergence of sequence and series
- To be able to recognize convergent, divergent, bounded, Cauchy and monotone sequences
- To be able to understand the concept of Riemann integrability and its properties

UNIT 1 THE REAL NUMBERS AND PROPERTIES **09 Hrs.**

Sets and Elements, operations on sets, functions, real valued functions, equivalence, least upper bounds.

UNIT 2 SEQUENCES **12 Hrs.**

Definition of sequence and subsequence, limit of a sequence, convergent sequences, divergent sequences, bounded sequences, monotone sequences, operations on convergent sequences, limit inferior, limit superior, Cauchy sequences.

UNIT 3 CONVERGENCE AND DIVERGENCE: SEQUENCE, INFINITE SERIES AND IMPROPER INTEGRALS **10 Hrs.**

Convergence and divergence, Series with non – negative terms, alternating series, conditional and absolute convergence, conditions for absolute convergence. Convergence and Divergence of Improper Integrals

UNIT 4 IMPROPER INTEGRALS **09 Hrs.**

Riemann integrability & integrals of bounded functions over bounded intervals, Darboux's Theorem, Equivalent definition of integrability and integrals, Conditions for integrability, Particular classes of bounded integrable functions, Properties of integrable functions, Function defined by a definite integral, Theorems of Integral Calculus (statement only)

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify whether the sequence and series are convergent or divergent
CO2 – Understand the properties of Riemann integrability
CO3 – Apply the acquired knowledge of convergence and divergence in practical problems
CO4 – Analyze the convergence and divergence of improper integrals
CO5 – Evaluating the problems of Riemann integration
CO6 – Develop abstract ideas in constructing rigorous mathematical proofs.

TEXT/REFERENCE BOOKS

1. W. Rudin, Principles of Mathematical Analysis, (McGraw Hill, 1976)
2. R. G. Bartle, Introduction to Real Analysis, (John Wiley and Sons, 2000)
3. T. M. Apostol, Mathematical Analysis, (Addison-Wesley Publishing Company, 1974)
4. A. J. Kosmala, Introductory Mathematical Analysis, (WCB Company , 1995)
5. W. R. Parzynski and P. W. Zipse, Introduction to Mathematical Analysis, (McGraw Hill Company, 1982)
6. H. S. Gaskill and P. P. Narayanaswami, Elements of Real Analysis, (Prentice Hall, 1988)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM205E					Probability and Statistics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the concept of probability and probability distribution function.
- To be able to obtain the statistical measure of various real world problem.
- To be able to analyze the probability distribution in view of various problems of engineering.
- To be able study various central tendency, curve fitting and correlation.

UNIT 1 PROBABILITY **08 Hrs.**

Sample space and events, Axioms of Probability function, Properties of probability function, Conditional Probability, Total Probability Baye's Theorem

UNIT 2 RANDOM VARIABLES **12 Hrs.**

Random variables. Discrete random variable, continuous random variable, Expectation, Variance, Moment generating function,

UNIT 3 DISTRIBUTION FUNCTIONS **10 Hrs.**

Discrete probability distribution functions, Binomial distribution, Negative binomial distribution, Poisson distribution, Continuous probability density function, Normal distribution, t, Exponential, χ^2 and F distributions, Joint distributions and their Mean, Variance and Covariance.

UNIT 4 CURVE FITTING AND REGRESSION **10 Hrs.**

Measure of central tendency, Curve fitting, Correlation, simple correlation, partial correlation, regression analysis,

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Identify the use of probability engineering aspects.
CO2 – Understand the concept of probability and statistics.
CO3 – Develop the ability to apply appropriate probability distribution in context with engineering problems.
CO4 – Analyze the obtained statistical solution in context with theory.
CO5 – Appraise mathematical problems in terms of statistics from real to complex domains.
CO6 – Evaluate problems on various central tendencies, fitting of curve, and regression and correlation.

TEXT/REFERENCE BOOKS

1. Probability and Statistics for Engineering and the Sciences, Jay L. Devore, Cenage Learning.
2. Probability & Statistics For Engineers & Scientists, 8/E, by Ronald E. Walpole, Sharon L. Myers and Keying Ye. Pearson Education
3. Sheldon M. Ross, "Introduction to Probability Models" Academic Press, 10th edition
4. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, fourth edition.
5. S.C. Gupta & V.K. Kapoor, "Fundamentals of Mathematical Statistics" Sultan Chand & Sons, Eleventh Edition

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester IV			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**
1.	20BSM206T	Applied Statistics	3	1	0	4	4	25	50	25	--	--	100
2.	20BSM207T	Partial Differential Equations	3	1	0	4	4	25	50	25	--	--	100
3.	20BSM208T	Basic Linear Algebra	3	1	0	4	4	25	50	25	--	--	100
4.	20BSM209P	MATLAB	0	0	2	1	2	--	--	--	50	50	100
5.	20BSM210T	Programming with Python	3	0	0	3	3	25	50	25	--	--	100
6.	20BSM210P	Programming with Python Lab.	0	0	2	1	2	--	--	--	50	50	100
7.		Elective 1	0	0	2	1	2	--	--	--	50	50	100
8.		Elective 2	3	0	0	3	3	25	50	25	--	--	100
		Total	**12**	**3**	**4**	**17**	**19**						**600**

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam.

Elective 1 and 2 are to be floated and taught by other departments.

Elective 1		**Elective 2**	
16A205	Physics Elective - 2	17A414	Advanced Atmospheric Science
16A210	Chemistry Elective-2 (Environmental Chemistry)	17A409	Rural Development in India
		17A408	Statistics
		20A435	Educational Psychology
		20A434	Cognitive Psychology
		17A420	Principles of Financial Management
		17A412	Soft Skills

20BSM206T					Applied Statistics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	0	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to evaluate problems related to probability and distribution.
- To be able to obtain the central measure of various data related to real world problems.
- To be able to understand data collection, its distribution and testing.
- To be able to analyze the data related to various fields of science and engineering.

UNIT 1 PROBABILITY AND DISTRIBUTION **08 Hrs.**

Sample Space and Events; Axioms, Interpretations and Properties of Probability; Expectation; conditional Probability; Total probability, Bayes' Rule, Random variables; Measures of central tendency and dispersion

UNIT 2 PARAMETER ESTIMATION **10 Hrs.**

The central limit theorem. General concepts of estimation, point estimation. Interval estimation, sampling distributions and the concept of standard error, confidence levels, confidence intervals based on a single sample and two samples. Concepts of maximum likelihood estimators.

UNIT 3 SAMPLING DISTRIBUTION **12 Hrs.**

Hypothesis testing: Introduction, Type I and Type II errors, tests concerning the mean and variance based on a single sample and two samples. Use of p-values. Analysis of Variance and the F-test. One way and Two way Models. Covariance and correlation, hypothesis tests for the correlation coefficient. Contingency tables, two-way tables.

UNIT 4 ANALYSIS OF VARIANCE **10 Hrs.**

Simple linear regression, estimating model parameters – the method of least squares; inferences about slope parameters, coefficient of determination, predicting Y values, prediction intervals. Introduction to multiple regression and its assumptions, estimating parameters, hypothesis testing for coefficients, ANOVA in regression. Data analysis using computer software.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of probability in engineering aspects.
CO2 – Understand the concept of probability distribution and hypothesis test.
CO3 – Develop the ability to apply appropriate tool/method to extract the solutions of engineering problems.
CO4 – Analyze the obtained solution of data analysis in context with theory.
CO5 – Appraise mathematical/statistical problems from real to complex domain.
CO6 – Evaluate problems on analysis of variance.

TEXT/REFERENCE BOOKS

1. Probability and Statistics for Engineering and the Sciences, Jay L. Devore, Cenage Learning.
2. Probability & Statistics For Engineers & Scientists, 8/E, by Ronald E. Walpole, Sharon L. Myers and Keying Ye. Pearson Education
3. Sheldon M. Ross, Introduction to Probability Models, Academic Press, 10th edition
4. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, fourth edition.
5. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Eleventh Edition

.END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM207T					Partial Differential Equations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To familiarize students with the origin of partial differential equations and their types.
- To introduce Lagrange's method, Charpit's general method and Jacobi's method.
- To classify second order PDEs and understand their canonical forms.
- To solve physical phenomena modeled as PDEs.

UNIT 1 FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS **12 Hrs.**

Formation of partial differential equations, definition and examples of linear and non-linear partial differential equations, order and degree of partial differential equations, linear partial differential equation of first order, equation solvable by direct integration, Lagrange's method, integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces, Charpit's general method, Jacobi's method.

UNIT 2 CLASSIFICATION AND CANONICAL FORMS **8 Hrs.**

Classification of second order PDE, Canonical forms, Canonical form for hyperbolic equation, Canonical form for parabolic equation, Canonical form for elliptic equation.

UNIT 3 SECOND ORDER PARTIAL DIFFERENTIAL EQUATIONS WITH CONSTANT AND VARIABLE COEFFICIENTS **8 Hrs.**

Homogeneous and nonhomogeneous equations with constant coefficients, Partial differential equations reducible to equations with constant coefficient, Second order PDE with variable coefficients

UNIT 4 APPLICATIONS **12 Hrs.**

Gravitational potential, Conservation laws and Burger's equations, Mathematical modeling of vibrating string, vibrating membrane, Derivation of Heat equation, Wave equation and Laplace equation, Method of separation of variables for second order PDE.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the formation and solution of PDEs of first, second and higher order.
CO2 – Classify and transform partial differential equations into canonical form.
CO3 – Solve first-order linear and nonlinear PDEs using Lagrange's, Charpit's and Jacobi's method.
CO4 – Apply a range of techniques to solve second order partial differential equations.
CO5 – Use partial differential equations to model physical phenomena.
CO6 – Solve some physical problems using a method of separation of variables.

TEXT/REFERENCE BOOKS

1. Myint-U, Tyn & Debnath, Lokenath, Linear Partial Differential Equation for Scientists and Engineers (4th ed.), 2007.
2. K. S. Rao: Introduction to Partial Differential Equations, PHI Learning Pvt Ltd, New Delhi, 2010
3. Sneddon, I. N. Elements of Partial Differential Equations, Dover Publications, 2006.
4. Stavroulakis, Ioannis P & Tersian, Stepan A. Partial Differential Equations: An Introduction with Mathematica and MAPLE, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM208T					Basic Linear Algebra					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide students with a good understanding of the concepts and methods of linear algebra.
- To help the students develop the ability to solve problems involving concepts in matrices.
- To connect linear algebra to other fields both within and without mathematics.
- To develop abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to linear algebra.

UNIT 1 MATRIX THEORY – I **08 Hrs.**

Matrices, Matrix Operations, Special Types of matrices, Elementary Matrices, inverse of Matrix, Rank and its properties, diagonal and orthogonal matrix, Determinants and its properties, Application of determinants.

UNIT 2 MATRIX THEORY – II **10 Hrs.**

System of Linear Equations: Introduction to systems of Linear Equations, geometry of linear equations, elementary operations on matrix, row-reduced echelon matrices, applying row reduction to obtain the inverse of a matrix, Solution of system of equation by Matrix inversion, Cramer's rule, Gauss Elimination and Gauss Jordan Elimination Method, Conditions for consistency of the system.

UNIT 3 VECTOR SPACES, LINEAR TRANSFORMATION AND INNER PRODUCT SPACES **12 Hrs.**

Euclidean n - space, Vector space and Subspaces, Linear dependence and Independence; Basis, Dimension, Linear Transformations and its relevant theories related with matrices, Row space, Null space; column space and rank of a matrix, Rank and Nullity, Dimension Theorem, Inner product, Orthogonality in Inner Product Spaces, Orthonormal Bases; Gram-Schmidt process, Least squares approximation, Orthogonal Matrices.

UNIT 4 EIGENVALUES AND EIGENVECTORS **10 Hrs.**

EigenValues and EigenVectors, Properties of Eigenvalues, Diagonalization, Cayley-Hamilton theorem and its application, bilinear and quadratic forms.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of matrices in real world problems.
CO2 – Understand the applications of systems of linear equations in various science and engineering fields.
CO3 – Explain the behavior of a set of vectors on the basis of linear dependence or independence.
CO4 – Analyze the interconnection of Vector spaces, Inner product spaces and orthogonality.
CO5 – Appraise mathematical problems pertaining to rank and nullity which are related with many other mathematical notions.
CO6 – Formulate problems based upon Eigenvalues and Eigenvectors and construct their real applications in various technological fields.

TEXT / REFERENCE BOOKS

1. S. Lipschutz, M. Lipson, Linear Algebra, Schaum's outline series, 4th ed., McGraw-Hill Education India Pvt. Ltd - New Delhi, 2009.
2. H. Anton, Elementary Linear Algebra with Applications, 11th ed., John Wiley, 2013.
3. E. Kreyszig, Advanced Engineering mathematics, 10th ed., John Wiley, 2015.
4. G. Strang, Linear Algebra and its applications, 4th ed., Cengage Learning, 2005.
5. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM210T					Programming with Python					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25			100

COURSE OBJECTIVES

- Understanding the MATLAB environment.
- Performing simple calculations using Matlab.
- Implementation of object oriented programming concepts in PYTHON.
- Ability to carry out simple numerical computations and analysis using MATLAB and PYTHON

UNIT 1 INTRODUCTION TO MATLAB **9 Hrs.**

MATLAB Environment: Defining Variables, Functions, Display Formats, Saving the variables stored in Memory, Complex Numbers, Matrices and Vectors, Strings, Input and Output Statements: MATLAB Programmed output, MATLAB programmed input, Plotting in MATLAB, Introducing MATLAB build-in functions.

UNIT 2 MATLAB CONTROL FLOW **10 Hrs.**

IF-END, IF-ELSE-END, ELSE-IF, SWITCH-CASE, FOR Loops: Single FOR loops, Nested FOR-Loops, Special Case of the FOR Loop, WHILE Loops, Functions: General Structure of a function, Scope of Variables, Passing Parameters, Global Variables, The RETURN Statement, Recursive functions.

UNIT 3 INTRODUCTION TO PYTHON **10 Hrs.**

The basic elements of Python, Branching programs, Strings and Input, Iteration Functions and Scoping, Specifications, Recursion, Global variables, Modules, Testing, Debugging

UNIT 4 STRUCTURED TYPES, MUTABILITY **11 Hrs.**

Tuples, Lists and Mutability, Functions as Objects, Strings, Tuples and Lists, Dictionaries,Handling exceptions, Exceptions as a control flow mechanism, Assertions, Abstract Data Types and Classes, Inheritance, encapsulation.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Explain the scripts and functions using MATLAB.

CO2 – Demonstrate the capacity of problem solving and programming capability.

CO3 – Apply data structures available in Python libraries.

CO4 – Analyze simple algorithms to solve problems.

CO5 – Evaluate scientific/ mathematical problems by writing simple programs in MATLAB.

CO6 – Design and program Python applications.

TEXT/REFERENCE BOOKS

1. Rudra Pratap**:** Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers, Oxford, 2010.
2. Marc E. Herniter: Programming in MATLAB, 1st Ed., Cengage Learning, 2000.
3. John V Guttag, Introduction to Computation and Programming Using Python, Prentice Hall of India.
4. Allen Downey, Jeffrey Elkner and Chris Meyers, How to think like a Computer Scientist, Learning with Python, Green Tea Press.
5. Swaroop C H., A Byte of Python,, http://www.swaroopch.com/notes/python.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100 **Exam duration: 3 Hrs.**

Part A: 6 questions of 4 marks each 24 Marks

Part B: 6 questions of 8 marks each 48 Marks

Part C: 2 questions of 14 marks each 28 Marks

COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester V			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**
1.	20BSM301T	Numerical Analysis	3	1	0	4	4	25	50	25	--	--	100
2.	20BSM302T	Advanced Ordinary Differential Equations	3	1	0	4	4	25	50	25	--	--	100
3.	20BSM303T	Complex Analysis	3	1	0	4	4	25	50	25	--	--	100
4.	20BSM304T	Fluid Mechanics	3	1	0	4	4	25	50	25	--	--	100
5.	20BSM305T	Advanced Linear Algebra	3	1	0	4	4	25	50	25	--	--	100
6.	20BSM306E	Special Functions	3	0	0	3	3	25	50	25	--	--	100
		Total	**18**	**5**	**0**	**23**	**23**						**600**

IA- Internal Assessment, MS-Mid Semester; ES – End Semester Exam.

20BSM301T					NUMERICAL ANALYSIS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the elements of error analysis for numerical methods.
- To derive and use appropriate numerical methods to solve algebraic and transcendental equations.
- To introduce appropriate numerical methods to solve interpolation based problems.
- To introduce various techniques to solve initial and boundary value problems in differential equations.

UNIT 1 NUMERICAL METHODS FOR SOLVING ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 10 Hrs.

Definition and sources of errors, Propagation of errors, Sensitivity and conditioning, Stability and accuracy, Floating-point arithmetic and rounding errors; Bisection method, False position method, Fixed point iteration method, Newton's method and secant method for solving equations, Convergence analysis with order of convergence.

UNIT 2 INTERPOLATION 10 Hrs.

Lagrange and Newton interpolations, Piecewise linear interpolation, Cubic spline interpolation, Finite difference operators, Gregory□Newton forward and backward difference interpolations.

UNIT 3 NUMERICAL DIFFERENTIATION AND INTEGRATION 10 Hrs.

First order and higher order approximation for first derivative, Approximation for second derivative; Numerical integration: Trapezoidal rule, Simpson's rules and error analysis, Bulirsch□Stoer extrapolation methods, Richardson extrapolation.

UNIT 4 INITIAL AND BOUNDARY VALUE PROBLEMS OF DIFFERENTIAL EQUATIONS 10 Hrs.

Euler's method, Runge□Kutta methods, Higher order one step method, Multi-step methods; Finite difference method, Shooting method.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the errors, source of error and its effect on any numerical computations.
CO2 – Solve algebraic and transcendental equations by various numerical methods.
CO3 – Use various interpolating and extrapolating methods.
CO4 – Solve initial and boundary value problems numerically.
CO5 – Analyze the order of convergence of various numerical methods.
CO6 – Evaluate the integrals numerically.

TEXT/REFERENCE BOOKS

1. Jain, M.K., Iyengar, S.R.K., and Jain, R.K., Numerical Methods for Scientific and Engineering Computation, New Age International Publisher (2012).
2. Burden R. L. and Faires J. D., Numerical Analysis, Brooks Cole, 2004.
3. Gerald, C.F., and Wheatley P.O., Applied Numerical Analysis, Addison Wesley (2003).
4. Atkinson, K. E. and W. Han, Elementary Numerical Analysis, John Wiley & sons (2004).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM302T					ADVANCED ORDINARY DIFFERENTIAL EQUATIONS					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concept of differential equations.
- To analyze the concept Existence and Uniqueness of solutions
- To be able to formulate and find solutions to more complex mathematical problems encountered in the applied sciences.
- To introduce various techniques to solve boundary value problems in differential equations.

UNIT 1 LINEAR DIFFERENTIAL~~DIFFERENTIL~~ EQUATIONS WITH CONSTANT AND VARIABLE~~VARIBALE~~ COEFFICIENTS. 10 Hrs.

Basic Concepts and Linear Equations of the First Order: Classification, Initial and Boundary Value problems, First Order Linear equation, Exact Equations; Linear Differential Equations of Higher Order: Higher Order Equations, Linear Independence, Equation with constant coefficients, Equation with Variable Coefficients, Wronskian, Method of Variation of Parameters, Reduction of the order of equation.

UNIT 2 SERIES SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS. 10 Hrs.

Existence and Uniqueness of solutions: Successive Approximations, Picard's theorem and its Proof, Some Examples, Ordinary and Singular Points, Series Solution Method

UNIT 3 SYSTEM OF DIFFERENTIAL EQUATIONS 10 Hrs.

Problem Systems of Linear Differential Equations: System of First Order Equations, Existence and Uniqueness Theorem, Fundamental Matrix, The eigenvalue-eigenvector method of finding solution, Non homogeneous Linear Systems, Linear Systems with Constant Coefficients, Linear Systems with Periodic Coefficients, Boundary Value Problems: Sturm Liouville problem, Green's~~Greens~~ Function

UNIT 4 APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS. 10 Hrs.

Oscillations of Second Order Equations: Sturm Comparison Theorem, Elementary Linear Oscillations, Oscillations of $x'' + a(t)x = 0$, Stability of linear systems, stability of equilibrium solutions, The phase-plane, Phase portraits of linear systems

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the concept of existence and uniqueness of ordinary differential equations
CO2 – Apply the appropriate method for the solution of non-linear ordinary differential equations
CO3 – Use Solution technique to solve the system of first order equations
CO4 – Solve initial and boundary value problems numerically.
CO5 – Analyze solutions of various kind of differential equations
CO6 – Evaluate the second order differential equations.

TEXT/REFERENCE BOOKS

1. S.G. Deo, V Lakshmikantham, V Raghvendra, Ordinary Differential Equations, McGraw-Hill Publishing Company Limited, Second Edition, (2015).
2. Edwards and Panney, Differential Equations, Prentice Hall, Third Edition, (2008).
3. E.L. Ince, Ian N. Sneddon, The Solution of Ordinary Differential Equation, Longman (1987).
4. M D Raisinghania, Advanced Differential Equations, S. Chand (2018).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	Exam Duration: 3 Hrs.
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM303T					Complex Analysis					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To explain the need of different co-ordinate systems.
- To enable students to visualize three dimensional objects.
- To acquaint the students with the guiding curves of 3D solids.
- To make students understand the basics of central conicoids.

UNIT 1 COMPLEX VARIABLES **09 Hrs.**

Functions of a complex variable, Limit, continuity and differentiability of a complex function, Conformal Mapping.

UNIT 2 ANALYTIC FUNCTIONS **11 Hrs.**

Analytic functions, Cauchy and Riemann equations (Cartesian and polar form), Harmonic functions, harmonic conjugate, Construction of analytic functions.

UNIT 3 COMPLEX INTEGRATION **10 Hrs.**

Complex integrals, Cauchy's theorem, Simply and Multiply connected domains, Cauchy Goursat theorem, Cauchy's integral formula, Morera's Theorem, Taylor's series, Laurent's series, Expansion of function, Zeroes of analytic functions, Poles and singularities, types of singularities.

UNIT 4 THEORY OF RESIDUES **10 Hrs.**

Residues, Evaluating residues at poles, Cauchy Residue theorem, Evaluation of Improper real integrals using Cauchy residue theorem.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the need for a Complex Number System and outline its relation to other existing number systems.

CO2 – Describe a function of complex variable and discuss basic mathematical operations with complex numbers.

CO3 – Apply the Cauchy Riemann Equation to demonstrate that a function is analytic.

CO4 – Classify singularities, and determine the singularities of a function

CO5 – Evaluate improper integrals and real definite integrals using Cauchy Residue theorem.

CO6 – Construct analytic functions by two methods.

TEXT/REFERENCE BOOKS

1. L. V. Ahlfors, Complex Analysis, 3rd ed., McGraw Hill Book Company, 1979.
2. J. B. Conway, Functions of one complex variable, 2nd ed., Narosa Publishing House, 2012
3. S. Ponnusamy , Foundations of Complex analysis, Narosa Publishing House, Second Edition, 2011.
4. James Ward Brown and Ruel V. Churchill , Complex variables and Applications, 9th ed., McGraw Hill, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM304T					Fluid Mechanics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To lay a foundation of fundamentals of fluid mechanics
- To be able to derive various conservation laws.
- To formulate and solve the basic problems in fluid mechanics
- To use this subject as a foundation for research in this field in higher studies.

UNIT 1 BASIC CONCEPTS **08 Hrs.**

Fluids, Types of Fluids, Fluid Properties: Density, Viscosity, Pressure, Temperature, Thermal conductivity, Specific heat, Specific weight, Specific volume, Specific gravity, Surface tension, Vapor pressure.

UNIT 2 KINEMATICS OF THE FLOW FIELD **11Hrs.**

Lagrangian method, Eulerian method, Relationship between Lagrangian and Eulerian method. Definitions: Steady and unsteady flows, Uniform and non-uniform flows, One, two and three dimensional flows, axisymmetric flow, Line of flow, Streamline, Path line, Stream surface, Stream tube, Streak tube. Velocity of the fluid particle at a point. Local, convective and material derivatives. Equation of continuity, Equation of continuity in Cartesian and Cylindrical coordinates. Equation of continuity (Lagrangian method), equivalence of the two forms of equation of continuity. Velocity potential, irrotational flow, rotational flow. Vorticity, Vorticity vector, Vortex lines, Vortex tubes. Boundary surfaces

UNIT 3 CONSERVATION OF MOMENTUM **10 Hrs.**

Euler's equation of motion along a streamline, Equation of motion of an inviscid fluid, Equation of motion of an inviscid fluid (Cartesian coordinates), Cauchy's integral. Bernoulli's equation. Conservative field of force, Integration of Euler's equation. Helmholtz equation. Impulsive motion of a fluid. Energy equation.

UNIT 4 VISCOUS FLUID FLOWS **11 Hrs.**

Stress analysis at a point, State of stress at a point, Symmetry of stress tensor. Stress in a fluid at rest. Stress in a fluid in motion. Transformation of stress components, Tensor character of stress matrix. Orthogonal principle directions. Strain analysis. Rate of strain quadratic. Transformation of rates of strain. Relation between stress and rate of strain. Navier-Stokes equation of motion of a viscous fluid. Limitations of the Navier-Stokes equation. Equation of energy. Dissipation of energy. Dimensional analysis

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Define the basic terminologies in fluid mechanics.

CO2 – Understand the Lagrangian and Eulerian descriptions of motion.

CO3 – Explain various conservation laws and their importance in Fluid Mechanics.

CO4 – Differentiate local, convective and material derivative and understand its applications.

CO5 – Appraise then notion of stresses and strains in fluid.

CO6 – Formulate the Navier-Stokes equations of motion along with energy equation.

TEXT/REFERENCE BOOKS

1. M. D. Raisinghaniya, Fluid Dynamics, S. Chand, 2003.
2. P. Kundu, I. M. Cohen, Fluid Mechanics, 4th ed., Academic Press, 2010.
3. M. C. Potter, D. C. Wiggert, Schaums Ouline of Fluid Mechanics, McGraw-Hill, 2007.
4. S. Swarup, Fluid Dynamics, 13th ed., Krishna Prakashan, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM305T					Advanced Linear Algebra					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide students with a good understanding of the concepts and methods of linear algebra.
- To help the students develop the ability to solve problems involving concepts in matrices.
- To connect linear algebra to other fields both within and without mathematics.
- To develop abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to linear algebra.

UNIT 1 VECTOR SPACE **10 Hrs.**

Review of vector space and subspace; Linear dependence/Independence, Basis and Dimension of a vector space; Coordinates with respect to a basis; symmetric and positive definite matrices.

UNIT 2 LINEAR TRANSFORM **10 Hrs.**

Linear Transformation and change of basis, Image of a basis, Range Space and Rank, Null Space and Nullity: Rank-Nullity theorem, Matrix Representation of a linear transformation, Linear Operators on Rn and their representation as square matrices, Composition of Linear Transformations and Matrix Multiplication, Invertibility and Isomorphism.

UNIT 3 EIGENVALUES AND EIGENVECTORS **10 Hrs.**

Review of Eigenvalues~~Eigen values~~ and eigenvectors of a matrix, Eigenvalues~~Eigen values~~ and eigenvectors of a linear operator, Properties of Eigenvalues~~Eigen values~~ and Eigenvectors~~Eigen vectors~~ of Hermitian, skew-Hermitian, Unitary, and Normal matrices (including symmetric, skew-symmetric, and orthogonal matrices), Diagonalization, Diagonalizability of a linear operator, Matrix Limits and Markov Chains.

UNIT 4 INNER PRODUCT SPACE **10 Hrs.**

Inner Products and Norms, Orthogonal Matrices, Angle and Orthogonality in Inner Product Spaces, Orthogonal Basis, Orthonormal Basis, Orthogonal Projection, Projections and Least Squares, Gram Schmidt Orthogonalization Process and Orthogonal Complements, Adjoint of a linear Operator, Normal and Self Adjoint Operators

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of matrices in real world problems.

CO2 – Understand the applications of systems~~system~~ of linear equations in various science and engineering fields.

CO3 – Explain the behavior of a set of vectors on the basis of linear dependence or independence.

CO4 – Analyze the interconnection of Vector spaces, Inner product spaces and orthogonality.

CO5 – Appraise mathematical problems pertaining to rank and nullity which are related with many other mathematical notions.

CO6 – Formulate problems based upon Eigenvalues and Eigenvectors and construct their real applications in various technological fields.

TEXT/REFERENCE BOOKS

1. S. Lipschutz, M. Lipson, Linear Algebra, Schaum's outline series, 4th ed., McGraw-Hill Education India Pvt. Ltd - New Delhi, 2009.
2. H. Anton, Elementary Linear Algebra with Applications, 11th ed., John Wiley, 2013.
3. E. Kreyszig, Advanced Engineering mathematics, 10th ed., John Wiley, 2015.
4. G. Strang, Linear Algebra and its applications, 4th ed., Cengage Learning, 2005.
5. K. Hoffman and R. A. Kunze, Linear Algebra, Prentice Hall of India, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM306E					Special Functions					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the concept of important special functions.
- To be able to obtain the solution of equation in the form of special functions.
- To be able to analyze the use of special function in real life problems.
- To be able study the advantage of special function as solution of various real world problems.

UNIT 1 GAMMA AND BETA FUNCTIONS **08 Hrs.**

The Gamma and Beta Functions: Euler's integral for Γ(z), the beta function, factorial function.

UNIT 2 BESSEL EQUATION **10 Hrs.**

Bessel equation and its solution, Bessel function of first and second kind of order *n*. Recurrence relations, Generating function, Orthogonality of Bessel's function.

UNIT 3 LEGENDRE EQUATION **10 Hrs.**

Legendre equation and its solution. Legendre's polynomial of degree *n*. Recurrence relations, orthogonal properties of Legendre's polynomial, Rodrigue's formula, Legendre's polynomial.

UNIT 4 HYPERGEOMETRIC FUNCTION **12 Hrs.**

The Hypergeometric function: An integral representation. Its differential equation and solutions. , F(a,b,c;1) as a function of the parameters, evaluation of F(a,b,c;1), contiguous function relations, the hypergeometric differential equation, logarithmic solutions of the hypergeometric equation, F(a,b,c;z) as a function of its parameters

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of special functions and polynomials
CO2 – Understand the concept of Beta and Gamma function in evaluation of integrals.
CO3 – Develop the ability to apply Bessel function to solve differential equations.
CO4 – Analyze the obtained solution in context with special functions.
CO5 – Appraise mathematical problems in term of special functions from real to complex domain.
CO6 – Evaluate problems on understanding of how physical phenomena are modeled using special functions.

TEXT/REFERENCE BOOKS

1. M.D. Raisinghania, Advanced differential equations, S Chand, (19th edition), 1995.
2. L.C. Andrews ,Special Functions of Mathematics for Engineers, SPIE Press, 1992.
3. L.J. Slater,Generalized Hypergeometric Functions , Cambridge University Press; Reissue edition ,2008.
4. Z. X. Wang and D. R. Guo, Special Functions, World Scientific publishing Co., 1989.
5. Gabor Szego, Orthogonal Polynomials, American mathematical society, 1939.
6. L. Debnath, Integral transforms and their Applications, CRC Press, New YorkLondon- Tokyo, 1995.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester VI			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**
1.	20BSM307T	Linear Programming	3	1	0	4	4	25	50	25	--	--	100
2.	20BSM308T	Analysis - II	3	1	0	4	4	25	50	25	--	--	100
3.	20BSM309T	Integral Transform	3	1	0	4	4	25	50	25	--	--	100
4.	20BSM310T	Modern Algebra	3	1	0	4	4	25	50	25	--	--	100
5.	20BSM311T	Object Oriented Programming	3	1	0	4	4	25	50	25	--	--	100
6.	20BSM312E	Financial Mathematics	3	0	0	3	3	25	50	25	--	--	100
		Total	**18**	**5**	**0**	**23**	**23**						**600**

Pandit Deendayal Petroleum University School of Liberal Studies

20BSM307T					LINEAR PROGRAMMING					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To get familiarize with the mathematical formulation of a real world problem.
- To acquaint with the problem solving techniques theoretically as well as graphically.
- To tackle several parameters into account while dealing with the problem.
- To make aware the students about the applications of various forms of Linear Programming.

UNIT 1 LINEAR PROGRAMMING: MODEL FORMULATION **10 Hrs**

Structure of linear Programming, Advantages and limitations of linear programming, Mathematical model of linear problem, applications of LP model to Production, marketing, engineering and transportation etc. Solution of LPP by graphical method

UNIT 2 SOLUTIONS BY SIMPLEX ALGORITHM **10 Hrs**

Simplex algorithm (maximization case), Big M method, Multiple solutions, unbounded solutions, infeasible solution

UNIT 3 INTEGER LINEAR PROGRAMMING AND DUALITY **10 Hrs**

Types of integer Programming problem, Gomory's all integer cutting plane method, Branch and Bound method, formulation of dual from LP problem, advantages of duality

UNIT 4 TRANSPORTATION AND ASSIGNMENT PROBLEM **10 Hrs.**

Methods for finding initial basic feasible solution: North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method, Optimal Solution: MODI Method, Assignment Problem: Hungarian Method

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – **Understand** a basic thoughtfulness for linear programming problem
CO2 – **Apply** the techniques of LPP to solve real world problems
CO3 – **Distinguish** use of different methods to various kinds of LPP on the basis of type of constraints and number of variable.
CO4 – **Judge** Importance of solution obtained in terms of uniqueness, bound and optimality
CO5 – **Formulate** mathematical model for management and technical problems using LPP concepts.
CO6 – **Create** an interest to solve transportation and assignment problems with its physical significance.

TEXT/REFERENCE BOOKS

5. S. I. Gass, Linear programming, Mc Graw Hill Book Company, 1985.
6. Kanti Swaroop, Man Mohan and P.K. Gupta, Operations Research, Sultan Chand and Sons, 2005.
7. Hamdy A. Taha, Operations Research: An Introduction, McMillan Publishing Company, 2007.
8. K. V. Mittal and C. Mohan, Optimization methods in Operations Research and System Analysis, New Age International Publications,1996

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A : 10 questions of 2 marks each	20 Marks (40 mins)
Part B: 5 questions 6 marks each	30 Marks (50 mins)
Part C: 5 questions 10 marks each	50 Marks (90 mins)

20BSM308T					ANALYSIS-II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. /Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the concept of countable, uncountable sets and metric space
- To be able to construct proofs in terms of implications, quantifiers, negations and contrapositives
- To be able to understand the concept of functions on metric spaces
- To understand the concept of point wise and uniform convergence

UNIT 1 METRIC SPACE **10 Hrs.**

Algebraic and Order properties of real numbers, Finite, Countable and Uncountable Sets, Cantor's set, Metric spaces, Open sets, Closed sets in a metric space, Closure of a set, Limit Points and their theorems.

UNIT 2 SEQUENCES **09 Hrs.**

Sequence, Convergence of a sequence, Cauchy Sequence, Limit point of a Sequence. Continuity, Completeness of a metric space, Dense Set.

UNIT 3 COMPACTNESS AND CONNECTEDNESS **12 Hrs.**

Compactness: Characterizations of compactness, Continuous functions on compact sets. Connectedness: Characterizations of connectedness, Continuous functions on connected sets

UNIT 4 SEQUENCES OF FUNCTIONS **09 Hrs.**

Definition of point-wise and uniform convergence, Examples of point-wise and uniform convergence, Uniform convergence and continuity, Uniform convergence and differentiation.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify rigorous arguments developing the theory of underpinning real analysis
CO2 – Understand fundamental properties of the real numbers that lead to the formal development of real analysis
CO3 – Apply the acquired knowledge in important practical problems and extend ideas to a new context.
CO4 – Analyze the concept of compactness, connectedness and uniform convergence with various aspects
CO5 – Evaluate the problems of the subsets of a metric space are open, closed, compact and/or connected
CO6 – Develop abstract ideas in analyzing proofs of theorems

TEXT/REFERENCE BOOKS

1. W. Rudin, Principles of Mathematical Analysis, (McGraw Hill, 1976)
2. R. G. Bartle, Introduction to Real Analysis, (John Wiley and Sons, 2000)
3. T. M. Apostol, Mathematical Analysis, (Addison-Wesley Publishing Company, 1974)
4. A. J. Kosmala, Introductory Mathematical Analysis, (WCB Company , 1995)
5. W. R. Parzynski and P. W. Zipse, Introduction to Mathematical Analysis, (McGraw Hill Company, 1982)
6. H. S. Gaskill and P. P. Narayanaswami, Elements of Real Analysis, (Prentice Hall, 1988)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

Pandit Deendayal Petroleum University **School of Liberal Studies**

20BSM309T					Integral Transforms					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs./Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To calculate the Laplace and Fourier transforms of standard functions both from the definition and by using tables.
- To study the real and complex forms of the Fourier series for standard periodic waveforms.
- To understand the basic properties of integral transforms and their applications in science and engineering problems.
- To make students familiar with the Dirichlet's conditions and using them to evaluate infinite series.

UNIT 1 LAPLACE TRANSFORMS **10Hrs**

Definition, existence conditions and basic properties of Laplace transforms, convolution theorem and its properties, differentiation and integration of Laplace transforms, inverse Laplace transforms and its properties.

UNIT 2 APPLICATIONS OF LAPLACE TRANSFORMS **10 HRS**

Solution of ODE's, PDE's, Initial and boundary value problems, evaluation of definite integrals, Solution of one dimensional heat and wave equations and Laplace equation by integral transform method.

UNIT 3 FOURIER SERIES **10 HRS.**

Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Even and odd functions and their Fourier expansions.

UNIT 4 FOURIER TRANSFORMS **10 HRS.**

Definition of Fourier transforms, Fourier transforms of generalized functions, basic properties of Fourier transforms, Fourier Cosine and Sine transforms, Fourier Integral formulas., Application of Fourier transforms

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – **Apply** the working knowledge of transform methods in solving differential equations arising in many research problems.

CO2 – **Interpret** the theoretical results suitably by developing a clear understanding of integral transforms.

CO3 – **Demonstrate** the knowledge of applying suitable transform methods in science and engineering applications.

CO4 – **Formulate** ideas, propositions and proofs of integral transform theory using the appropriate methods.

CO5 – **Create** more advanced aspects of transform methods.

CO6 – **Solve** mathematical problems using integral transform techniques.

TEXT/REFERENCE BOOKS

1. L. Debnath and D. Bhatta, Integral Transforms and Their Applications, Book World Enterprises, 2006.
2. **D**. Brian, Integral Transforms and Their Applications, Springer-Verlag New York, 3rd Ed., 2002.
3. J. Miles, Integral Transforms in Applied Mathematics, Cambridge University Press, 1971.
4. M.D. Raisinghania, Integral Equations and Boundary Value Problems, 2016.
5. R. P. Kanwal, Linear Integral Equations, Birkhäuser; 2nd edition, 1996.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A : 5 questions of 6 marks each	30 Marks
Part B: 6 questions 8 marks each	40 Marks
Part C: 2 questions 15 marks each	30 Marks

20BSM310T					Modern Algebra					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce the Algebra of number system.
- To gain knowledge and skills to enable them to handle mathematical operations, analyses and problems involving Algebra.
- To introduce the use of Abstract Algebra in Real world
- To get familiar with the subject for better understanding of the advanced courses at a higher level.

UNIT 1 GROUP THEORY-I **10 Hrs.**

Some sets of numbers, Mappings, Binary composition, Equivalence relation, Equivalence class, Group, Examples of Groups, Properties of Groups, Subgroup.

UNIT 2 GROUP THEORY-II **10 Hrs.**

Order of an element, Cyclic Group, Cosets and Lagrange's theorem, Product of two subgroups, Normal subgroups, Quotient Groups, Commutator subgroup.

UNIT 3 HOMOMORPHISMS AND PERMUTATIONS, AUTOMORPHISM AND CONJUGATE ELEMENTS **11 Hrs.**

Homomorphism, Theorems on Homomorphisms, Correspondence theorems, Cayley's theorem, Permutation group, Automorphism, Theorems on Automorphisms, Conjugate elements, Applications of class equation of a group.

UNIT 4 INTRODUCTION TO RINGS AND FIELDS **09 Hrs.**

Ring, Examples of Ring, Some properties of Rings, Integral Domain and Field, Basic Theorems on Integral Domain and Field, Sub-ring.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the Groups, Rings and Fields based on their properties.
CO2 – Understand the basic idea of algebra of numbers and algebraic structures.
CO3 – Explain a rigorous mathematical proof for any given theorem.
CO4 – Discuss the application of abstract algebra in different fields of science and engineering.
CO5 – Appraise this subject so that it can be applied in other subjects or in higher studies.
CO6 – Develop the higher order thinking skills so as to understand the algebraic proofs.

TEXT/REFERENCE BOOKS

1. J. A. Gallian, Contemporary Abstract Algebra, 8th ed., Cengage Learning, 2013.
2. A. R. Vasishtha, A. K. Vasishtha, Modern Algebra, Krishna Prakashan Media (P) Ltd., 2002.
3. M. Artin, Algebra, 2nd ed., Pearson, 2010.
4. D. S. Dummit, R. M. Foote, Abstract Algebra, 3rd ed., John Wiley & Sons, 2003.
5. I. N. Herstein, Topics in Algebra, 2nd ed., John Wiley and Sons, 1975 .

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM311T					Object Oriented Programming					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25			100

COURSE OBJECTIVES

- Understanding about object oriented programming.
- To make aware the concept of classes and objects.
- Understanding the process of exposing essential data and hiding the low level data.
- Understand the basics of constructors, destructors, inheritance and polymorphism.

UNIT 1 CONSTRUCTORS AND DESTRUCTORS **10 Hrs.**

Introduction, Basic of C and C^{++},constructors and destructors, types of constructors, destructors, declaration and application of constructors, Private constructor and destructors, program on constructors and destructors, memory management, Library of Python.

UNIT 2 INTRODUCTION TO OOP **10 Hrs.**

What is object oriented programming. Programming characteristics of object oriented languages, difference in C and C++, Basics of C++, Some simple C++ Program, Data types in C++, operators in C++, control structure in C++, I/O formatting.

UNIT 3 CLASSES AND OBJECTS **10 Hrs.**

Introduction to classes and objects, class, encapsulation, objects, member function, static member.

UNIT 4 INHERITANCE AND POLYMORPHISM **10 Hrs.**

Introduction and benefits, Types of Inheritance, Virtual functions and Function overriding, Polymorphism.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Apply the object oriented programming paradigm to write computer programs.
CO2 – Apply concept of function overloading which leads to more readable and maintainable code.
CO3 – Demonstrate the ability to apply concepts of inheritance and polymorphism.
CO4 – Analyse the memory by using constructor and destructor in programming.
CO5 – Evaluate mathematical problems by writing a simple program in an OOP approach.
CO6 – Create/manipulate objects belonging to the class.

TEXT/REFERENCE BOOKS:

1. E. Balagurusamy, Object-Oriented Programming with C++, Tata McGraw Hill.
2. R. Rajaram, Object Oriented Programming & C++, New Age International.
3. H. Schildt, C++ The complete Reference, 4th Ed, Tata McGraw Hill.
4. D. Samanta, Object-Oriented Programming with C++ and JAVA, PHI.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam duration: 3 Hrs.**

Part A: 6 questions of 4 marks each 24 Marks
Part B: 6 questions of 8 marks each 48 Marks
Part C: 2 questions of 14 marks each 28 Marks

20BSM312E					Financial Mathematics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand the basic concepts of the interest.
- To learn about different types of deterministic cash flows.
- To be able to understand about different types of random cash flows.
- To learn about different mathematical models related to financial derivatives.

UNIT 1 BASIC CONCEPTS **08 Hrs.**

Arbitrage, Return and Interest, Time Value of Money, Bonds, Shares and Indices, Models and Assumptions.

UNIT 2 DETERMINISTIC CASH FLOWS **10 Hrs.**

Net Present Value (NPV), Internal Rate of Return (IRR), Comparison of IRR and NPV, Bonds price and yield, Clean and Dirty Price, Price – Yield Curves, Duration, Term structure of Interest rates, Immunization, Convexity.

UNIT 3 RANDOM CASH FLOWS **09 Hrs.**

Random Returns, Portfolio Diagrams and Efficiency, Feasible Set, Markowitz Model, Financial Derivatives.

UNIT 4 OPTIONS & BLACK-SCHOLES MODEL **13 Hrs.**

Call Options, Put Options, Put-Call Parity, Binomial Options Pricing Model, Risk-Neutral Valuation, The Black-Scholes Formula, Options on Future, Options on Assets with Dividends, Black-Scholes and BOPM, Implied Volatility.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand the relationship between risk and profit.

CO2 – Explain various types of annuities and perpetuities in detail and apply them to solve financial transactions problems.

CO3 – Demonstrate understanding and competence with the financial models.

CO4 – Apply the concepts of random cash flows to evaluate returns and interest on various investments.

CO5 – Distinguish net present value and internal rate of return and understand their individual role.

CO6 – Create an ability to formulate return and interest on different investment like bonds, shares, mutual funds etc.

TEXT / REFERENCE BOOKS

7. Amber Habib, The Calculus of Finance, Universities Press, 1st ed.,2011.
8. G. Campolieti and R.N. Makarov, Financial Mathematics: A Comprehensive Treatment, CRC Press, 1st ed., 2014.
9. R.J. Williams, Introduction to Mathematics of Finance, American Mathematical Society, 2006.
10. J. R. Buchanan, An Undergraduate Introduction to Financial Mathematics, World Scientific, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester VII			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
			L	**T**	**P**	**C**	**Hrs/Wk**	**Theory**			**Practical**		**Total**
								MS	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**
1.	20BSM401T	Discrete Mathematics	3	1	0	4	4	25	50	25	--	--	100
2.	20BSM402T	Operation Research	3	1	0	4	4	25	50	25	--	--	100
3.	20BSM403T	Statics & Dynamics	3	1	0	4	4	25	50	25	--	--	100
4.	20BSM404T	Integral Equations	3	1	0	4	4	25	50	25	--	--	100
5.	20BSM405	Research Dissertation	0	0	0	6	0	--	--	--	--	--	100
6.	20BSM406	Seminar	0	0	0	4	0	--	--	--	--	--	100
		Total	**12**	**4**	**0**	**26**	**16**						**600**

20BSM401T					Discrete Mathematics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concept of recursive functions and its solution.
- To apply truth tables for validation of propositions.
- To apply the Karnaugh maps to simplify Boolean expression.
- To construct the finite state machine.

UNIT 1 RECURSIVE FUNCTIONS **10 Hrs.**

Recursive function, Recurrence relations (n^{th} order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), Generating function (closed form expression, properties of G.F., Solution of recurrence relation using G.F).

UNIT 2 PROPOSITIONAL LOGIC **10 Hrs.**

Proposition logic, Logical connectives, Truth tables, Tautologies, Contradiction, Normal forms (conjunctive and disjunctive), Modus ponens and modus tollens, Validity, Predicate logic, Universal and existential quantification. contrapositive, negation, and contradiction, Direct proof, Proof by using truth table.

UNIT 3 LANGUAGES, GRAMMARS AND MACHINES **10 Hrs.**

Alphabets and Words, Languages, Operations on Languages, Regular Languages, Finite State Automata, Grammars, Types of Grammars, Finite State Machine, State Diagram.

UNIT 4 BOOLEAN ALGEBRA **10 Hrs.**

Basic definitions, Duality, Boolean algebra as Lattices, SoP form for Sets, SoP form for Boolean algebra, Minimal Boolean expressions, Minimal SoP Form, Logic Gates and Circuits, Karnaugh maps.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand concepts needed to test the logic of a program.
CO2 – Apply the Karnaugh maps to simplify Boolean expression.
CO3 – Explain the concept of Languages and Grammar and its use.
CO4 – Construct the finite state machine.
CO5 – Defend and point out fallacious reasoning and propositions.
CO6 – Create and solve recurrence relations that arise in counting problems including problems of determining the time complexity of recursively defined algorithms.

TEXT / REFERENCE BOOKS

1. S. Lipschutz and M. Lipson, Discrete Mathematics, 3rd ed., Schaum Series (TMH), 1997.
2. Kenneth H Rosen, Discrete Mathematics and Its Applications, 7th ed., Tata McGraw Hill, 2011.
3. B. Kolman, , R. Busby and S. C. Ross, Discrete Mathematical Structures, 6th ed., Pearson, 2008.
4. T. Koshy, Discrete Mathematics with Applications, Academic Press Inc., 2004.
5. R. P. Grimaldi, Discrete and Combinatorial Mathematics, 5th ed., Pearson Education, 2006.
6. C.L. Liu, D.P. Mohapatra, Elements of Discrete Mathematics: **:** A Computer Oriented Approach, 4th ed., McGraw Hill Education, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM402T					Operations Research					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To get familiarize with the mathematical formulation of a real world queuing problems.
- To acquaint with stochastic approach of solving optimization problem.
- To understand decision making process with associated risks
- To make aware the students about the applications of various project planning and executions problem with the network analysis.

UNIT 1 QUEUING THEORY **10 Hrs.**

Queueing models: Introduction, Queueing components, ((M/M/1): (∞/FCFS)), ((M/M/1): (N/FCFS)), ((M/M/c) : (∞/FCFS)), ((M/Ek/1): (∞/FCFS)), ((M/M/R) : (K/GD)), K > R

UNIT 2 STOCHASTIC PROGRAMMING **10 Hrs.**

Introduction to stochastic programming, basic concepts of probability: random variable, probability mass function and density function, stochastic linear programming, stochastic non – linear programming

UNIT 3 DECISION THEORY **10 Hrs.**

Quantitative approach to management decision making-decision under conditions of uncertainity - Maximin-Maximax-Hurwics, Laplace and Mini-max regret criteria-Decision making under risk-EMV-EOL-EVPI criteria-decision tree analysis-Game theory

UNIT 4 NETWORK ANALYSIS **10 Hrs.**

CPM and PERT-Network concepts-construction of network diagram-numbering the events (Fulkerson's Rule), requirements-Network calculations-CPM-Concept of float-PERT probability considerations in PERT-calculation of float/slack under PERT-PERT calculations-points of similarities and dissimilarities in PERT and CPM-limitation of PERT and CPM.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Understand of queuing problems to predict traffic and idle time.
CO2 – Apply the concepts of probability to optimize non- linear problems by stochastic approach
CO3 – Distinguish among different decision making approaches with the amount of uncertainty and risk associated with it.
CO4 – Formulation of the alternative strategy to compete with one another using game theory.
CO5 – Formulation of different queuing models with appropriate assumptions to deal with a wide range of queuing problems.
CO6 – Create a network using PERT or CPM for timely completion of the proposed projects

TEXT/REFERENCE BOOKS

1. Operations Research, Sultan Chand and Sons, Kanti Swaroop, Man Mohan and P.K. Gupta, 2005.
2. Hamdy A. Taha, Operations Research: An Introduction, McMillan Publishing Company, 2007.
3. K. V. Mittal and C. Mohan, Optimization methods in Operations Research and System Analysis, New Age International Publications,1996
4. J K Sharma ,Operation Research: Theory and Applications, Laxmi publications, 6th edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM403T					Statics and Dynamics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To familiarize students with the importance of this subject in the field of science and engineering.
- To develop an understanding of the fundamental principles of statics and dynamics.
- To learn kinematics, kinetics of particle and rigid body, effect of friction on equilibrium.
- To analyze the statics of frames and machines, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies.

UNIT 1 EQUILIBRIUM OF RIGID BODIES **10 Hrs.**

Equilibrium of particles in 2-D and 3-D, Equivalent systems of Forces, moments, couples, Equilibrium of rigid bodies in 2-D, Equilibrium of rigid bodies in 3-D.

UNIT 2 APPLICATIONS **8 Hrs.**

Centroids and center of gravity, Moments of inertia, Analysis of structures: Trusses, frames and machines, Forces in beams, Friction.

UNIT 3 KINEMATICS OF PARTICLES **11 Hrs.**

Kinematics of particles, Rectilinear motion, Curvilinear motion, Newton's second law of motion, Motion of particles under central force, Kinetics of particles: energy and momentum methods.

UNIT 4 MOTION OF RIGID BODIES WITH APPLICATIONS **11 Hrs.**

Systems of particles, Plane motion of rigid bodies: Kinematics, forces and accelerations, Plane motion of rigid bodies: Kinetics, Energy and momentum methods, Angular momentum of rigid bodies in 3-D motion.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Demonstrate an understanding of the principles of kinematics and kinetics of particles and planar rigid bodies.
CO2 – Apply knowledge of mathematics to interpret problems involving frictional forces.
CO3 – Analyze different structural elements like trusses, frames and beams.
CO4 – Solve the problem related to bodies in dynamic Equilibrium and bodies undergoing forced and free vibration using the laws of kinetics.
CO5 – Evaluate problems in a systematic and logical manner including the ability to draw free-body diagrams.
CO6 – Formulate and solve the practical problems of statics and dynamics.

TEXT/REFERENCE BOOKS

1. I.H. Shames, Engineering Mechanics – Statics and Dynamics, 4th edition, Prentice–Hall of India Pvt. Ltd., 2003.
2. F.P. Beer and E.R. Johnston, Vector Mechanics for Engineers- Statics and Dynamics, 8th ed., McGraw Hill International Book Co., 2008.
3. R.C. Hibbeler, Engineering Mechanics, 12th edition, Pearson Education Pvt. Ltd., 2007.
4. J.L. Meriam, Dynamics, 5th edition, John Wiley & sons, 2003.
5. K. L. Kumar, Engineering Mechanics, 3rd edition, Tata McGraw Hill, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM404T					Integral Equations					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To introduce integral equations along with their relevance to the corresponding differential equations.
- To develop understanding of integral equations arising in several physical problems.
- To classify integral equations based on Volterra and Fredholm integral equations
- To make students familiar with the methods of solving integral equations.

UNIT 1 INTRODUCTION TO INTEGRAL EQUATIONS **10 Hrs.**

Linear integral equations, Volterra integral equation, Fredholm integral equation, Singular integral Equation, Non-linear integral Equation, Relation between differential and integral equation, Examples.

UNIT 2 SOLUTIONS OF INTEGRAL EQUATIONS **10 Hrs.**

Solution of a non-homogeneous Volterra's integral equation by the method of successive substitution, Determination of some resolvent kernels, Voletrra integral equation of first kind, Solution of Fredholm integral equation by the method of successive substitution, Iterated Kernels,

UNIT 3 FREDHOLM INTEGRAL EQUATIONS **10 Hrs.**

Fredholm Integral equations: Fredholm First Theorem, Unique solution of the non-homogeneous Fredholm integral equation, Hadamard's theorem, Fredholm Second theorem, Orthogonality of characteristics solutions, Solution of homogeneous integral equation.

UNIT 4 INTEGRAL EQUATIONS WITH SYMMETRIC KERNEL **10 Hrs.**

Symmetric kernel, Orthogonality, Orthogonality of fundamental functions, Eigenvalues~~Eigen values~~ of a symmetric kernel, Schmidt's solution of the non-homogeneous integral equations, Solution of the Fredholm integral equation of first kind.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Explain linear and non-linear Integral equations and solve them by suitable techniques.
CO2 – Demonstrate the working knowledge to solve integral equations arising in many research problems.
CO3 – Analyze mathematical problems using techniques from integral equations theory.
CO4 – Appraise theoretical results and determine if the solutions are reasonable.
CO5 – Formulate ideas, propositions and proofs of integral equations theory using the appropriate methods.
CO6 – Develop the skills to model various physical phenomena using integral equations.

TEXT/REFERENCE BOOKS

1. L. Debnath and D.D. Bhatta, Integral Transforms and Their Applications, Book World Enterprises, 2006.
2. M. Krasnov, A. Kiselev and G. Makarenko, Problems and Exercises in Integral Equations, Mir Publishers, 1971.
3. F.G Tricomi, Integral Equations, Dover Publications Inc. New York, 1985.
4. N.I. Muskhelishvili, Singular Integral Equations, Dover Publications Inc., New York, 2008.
5. R. P. Kanwal, Linear Integral Equations, Birkhauser publications, 2nd ed., 1996

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions 8 marks each	48 Marks
Part C: 2 questions 14 marks each	28 Marks

COURSE STRUCTURE FOR B.Sc. (MATHEMATICS)														
Semester VIII			**B.Sc. (Mathematics)**											
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**						
								Theory			**Practical**		**Total**	
			L	**T**	**P**	**C**	**Hrs/Wk**	**MS**	**ES**	**IA**	**L W**	**LE/Viva**	**Marks**	
1.	20BSM407T	Graph Theory	3	1	0	4	4	25	50	25	--	--	100	
2.	20BSM408T	Differential Geometry	3	1	0	4	4	25	50	25	--	--	100	
3.	20BSM409T	Topology	3	1	0	4	4	25	50	25	--	--	100	
4.	20BSM410T	Mathematical Physics	3	1	0	4	4	25	50	25	--	--	100	
5.	20BSM411T	Number Theory	3	1	0	4	4	25	50	25	--	--	100	
6.	20BSM412E	seminar	0	0	0	4	0	--	--	--	--	--	100	
		Total	**15**	**5**	**0**	**24**	**20**						**600**	

20BSM407T					GRAPH THEORY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the basic concept of graph theory.
- To learn graph theory based modeling and apply the same to solve real life problems.
- To study about trees and its shortest spanning algorithms.
- To define graph coloring and to represent graphs in computer memory.

UNIT 1 GRAPH THEORY **10 Hrs.**

Graphs and related definitions, Sub-graphs, Homomorphism and Isomorphism, Paths and Connectivity. Bipartite graph. Eulerian graph and Konigsberg bridge problem. Hamiltonian graph. Labeled and weighted graphs. Connected graphs, Disconnected graphs and components, Euler graphs, Operations on graphs, More on Euler graphs, Hamiltonian paths and circuits.

UNIT 2 DIRECTED GRAPHS **10 Hrs.**

Basic Definitions, Trees. Algebraic expressions and Polish notation. Sequential representation of Directed Graphs. Adjacency matrix. Shortest path. Binary trees, Strongly and weakly connected graphs, Rooted Trees, Minimum Spanning Tree, Warshall's algorithm – Shortest paths.

UNIT 3 PLANAR AND DUAL GRAPH **10 Hrs.**

Cut set, Properties of a cut set, Fundamental circuits and cut sets, Network flows, Planar graph, kurtowski's theorem, Detection of planarity, Dual of a graph, More on criteria of planarity.

UNIT 4 GRAPH COLORINGS **10 Hrs.**

Chromatic number, Chromatic partitioning, Coverings, Four color problem, Representing graphs in computer memory.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify planarity in a non-directed graph.
CO2 – Understand problems related to the graph theory.
CO3 – Apply Graph theory in related areas such as minimal-path problems and network flow problems.
CO4 – Analyze the graph colorings in real life domain.
CO5 – Comparison between Eulerian and Hamiltonian graphs.
CO6 – Design the computational aspects of mathematical problems.

TEXT / REFERENCE BOOKS

1. S. Lipschutz and M. Lipson, Discrete Mathematics, 3rd ed., Schaum Series (TMH), 1997.
2. Kenneth H Rosen, Discrete Mathematics and Its Applications, 7th ed., Tata McGraw Hill, 2011.
3. B. Kolman, , R. Busby and S. C. Ross, Discrete Mathematical Structures, 6th ed., Pearson, 2008.
4. T. Koshy, Discrete Mathematics with Applications, Academic Press Inc., 2004.
5. R. P. Grimaldi, Discrete and Combinatorial Mathematics, 5th ed., Pearson Education, 2006.
6. C.L. Liu, D.P. Mohapatra, Elements of Discrete Mathematics: **:** A Computer Oriented Approach, 4th ed., McGraw Hill Education, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM408T					DIFFERENTIAL GEOMETRY					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the concept of curvature of a space curve and signed curvature of a plane curve.
- To be able to understand the fundamental theorem for plane curves.
- To get introduced to the notion of Serret-Frenet frame for space curves and the involutes and evolutes of space curves with the help of examples.
- To be able to compute the curvature and torsion of space curves.

UNIT 1 THEORY OF SPACE CURVES **10 Hrs.**

Space curves, Parametrized Curves and Arc Length, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating plane, normal plane, rectifying plane and osculating circles and spheres. Fundamental Theorem of the Local Theory of Curves. Evolutes and involutes of curves, Helix and Bertrand curves

UNIT 2 THEORY OF SURFACES **10 Hrs.**

Regular Surfaces and Inverse Image of Regular Values, Parametric curves on surfaces, Change of Parameters and Differential Functions on Surfaces, The Tangent Plane, Differential of a map, first Fundamental form, angle between two curves on a surface, area under parametric curves, second Fundamental form, Developable surfaces, Minimal surfaces

UNIT 3 TENSORS **10 Hrs.**

Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction tensors, Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Algebra of tensors and contraction

UNIT 4 METRIC TENSOR **10 Hrs.**

Metric tensor and 3-index Christoffel symbols, Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify different types of surface curve.
CO2 – Understand problems related to theory of surface.
CO3 – Apply knowledge of surfaces in real world problem.
CO4 – Analyze the graph colorings in real life domain.
CO5 – Comparison between Tensors and Metric Tensor.
CO6 – Design the computational aspects of mathematical problems.

TEXT / REFERENCE BOOKS

1. M. Spivak, Calculus on Manifolds: A Modern Approach to Classical Theorems of Advanced Calculus, CRC press, 2018.
2. A.N. Pressley, Elementary Differential Geometry, Springer Science & Business Media, 2010.
3. B. O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
4. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM409T					Topology					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the difference of metric Space in Real Analysis and in terms of topology.
- To impart knowledge on the conceptual understanding of connectedness and compactness in topological aspects.
- To provide sufficient knowledge of the subject which can be used by student for in their respective domains of interest.
- To enhance the knowledge of "Ti" axioms to build strong fundamentals in order to understand advanced topological results.

UNIT 1 TOPOLOGICAL SPACES **10 Hrs.**

Topological spaces, Basis and sub-basis for a topology, Discrete topology, Product topology, Subspace topology, Quotient topology, comparison of topologies.

UNIT 2 TOPOLOGY IN REAL LINE **10 Hrs.**

Neighbourhood, Cluster points, Closure and interior points of a set, Definition and examples of a door space and dense set, Continuity in a topological space and homeomorphism.

UNIT 3 CONNECTEDNESS **10 Hrs.**

Definition and examples of connected and disconnected spaces, Connectedness in R, Relative topology, Connected subspaces, Open cover.

UNIT 4 COMPACTNESS **10 Hrs.**

Compactness in R1; R2 and metric space, Properties of compact spaces, Definition and examples of T0; T1; T2 - space, Hausdorff property of a metric space.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Identify the necessity of studying topological problems and to explore its importance with geometry as well
CO2 – Explain the structure of different topological spaces.
CO3 – Demonstrate the use of applications of set theory in terms of topological terminologies.
CO4 – Analyze mathematical notions geometrically.
CO5 – Appraise general topological structures by using the reasoning capability and logical thinking.
CO6 – Develop an appreciation of mathematical abstraction and generalization.

TEXT/REFERENCE BOOKS

1. G.F. Simmons, Introduction to Topology and Modern Analysis, 1st edition, McGraw Hill, 1963.
2. J.R. Munkres, Topology, 2nd edition, Prentice Hall, 1999.
3. K.D. Joshi, Introduction to General Topology, 2nd edition, New Age Publications, 1999.
4. S. Naimpally and J. Peters, Topology with Applications: Topological Spaces via Near and Far, World Scientific, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM410T					Mathematical Physics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	--	--	100

COURSE OBJECTIVES

- To be able to understand deep science concepts on the ground of tensors.
- To be able to apply the Z – Transforms in relevant physical problems.
- To be able to understand the role of Fourier series in periodic systems.
- To study the various aspects and properties of curvilinear co-ordinate system.

UNIT 1 BASICS OF TENSORS **08 Hrs.**

Summation convention, Kronecker delta, Determinant, Four vectors, transformation of coordinates, tensor, symmetric tensor, anti-symmetric tensor, algebra of tensors, contraction.

UNIT 2 Z – TRANSFORMS **10 Hrs.**

Introduction, sequence, representation of a sequence, definition of a z-transform, change of scale, shifting property, Inverse z-transform, solution of difference equations, Multiplication by K, Division by K, Initial value, final value, partial sum, convolution, convolution property of Casual sequence, Transform of Important sequences, Inverse of Z-transform by division

UNIT 3 FOURIER SERIES AND FOURIER TRANSFORM **12 Hrs.**

Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval's Identity and its applications, Complex Form of Fourier Series, Fourier Transform.

UNIT 4 CURVILINEAR CO-ORDINATE SYSTEM **10 Hrs.**

Coordinate systems, Orthogonal curvilinear co-ordinates, Condition for Orthogonality, Reciprocal sets of two triads of mutually orthogonal vectors, Gradient in terms of orthogonal curvilinear co-ordinates, Divergence in terms of orthogonal curvilinear co-ordinates, Curl in terms of curvilinear coordinates, Laplacian in terms of curvilinear co-ordinates.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 – Identify the use of tensors theoretically and relate them with the scalars and vectors and why the study evolved.
CO2 – Understand various application of tensors in Physics and other deep scientific phenomena on the basis of the knowledge gained.
CO3 – Explain the Z – Transforms to extract the solutions of engineering problems.
CO4 – Analyze various periodical systems on the ground of Fourier series.
CO5 – Appraise interconnection between rectangular and curvilinear co-ordinate system.
CO6 – Produce the relations of Gradient, Divergence and Curl in curvilinear co-ordinate system.

TEXT / REFERENCE BOOKS

1. J. K. Goyal, and K. P. Gupta, Theory of Relativity (Special & General), 22nd ed., Krishna Prakashan Media (P) Ltd., 2014.
2. G. B. Arfken, H. J. Weber and F. E., Harris, Mathematical Methods for Physicists, 4th ed., Elsevier, 2005.
3. H. K. Dass, Advanced Engineering Mathematics, 1st ed. (Reprint), S. Chand, 2009.
4. Mary L Boas, Mathematical Methods in Physical Science, 3rd ed., John Wiley & Sons, 2005.
5. B. D. Gupta, Mathematical Physics, 4th ed., Vikas Publishing House Pvt. Ltd., 2018
6. D. Spellman, M. Spiegel and S. Lipschutz, Vector Analysis, 2nd ed., Schaum's Outline Series, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs.**
Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM411T					Number Theory					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- Give the student a sense of basic idea of Number Theory .
- To understand the basic concepts of algorithms.
- To study the basic concepts of Prime Numbers.
- To understand the Congruences.
- To study the Primitive Roots and Quadratic Residues.

UNIT I INTRODUCTION: **08 Hrs.**

The Well Ordering Principle and Mathematical Induction, Divisibility and Division Algorithm: Integer Divisibility, Division algorithm, Greatest Common Divisor, Euclidean Algorithm.

UNIT II PRIME NUMBERS: **11 Hrs.**

The infinitude of primes, The fundamental theorem of arithmetic, Least Common Multiple, Linear Diophantine Equations.

UNIT III CONGRUENCES: **09 Hrs.**

Introduction to congruences, Residue Systems and Euler's phi function, Linear Congruences, The Chinese Remainder Theorem, Fermat Theorem

UNIT IV PRIMITIVE ROOTS AND QUADRATIC RESIDUES: **12 Hrs.**

The order of integers and Primitive Roots, Primitive Roots for Primes, The Existence of Primitive Roots, Quadratic Residues and Nonresidues.

40 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to
CO1 – Understand the basic idea of number theory.
CO2 – Understand the different types of algorithms.
CO3 – Understand the concept of prime numbers.
CO4 – Apply algorithms
CO5 – Apply the concepts of Primitive Roots.
CO6 – Apply the concepts Quadratic Residues

TEXTS / REFERENCES BOOKS

1. George E. Andrews, Number Theory, Dover, New York, 1994.
2. George E. Andrews, The Theory of Partitions, Cambridge Mathematical Library. Cambridge University Press, Cambridge,1998.
3. Tom M. Apostol, Introduction to Analytic Number Theory. Springer, NewYork, 1976.
4. A. Baker, Transcendantal Number Theory, Cambridge University Press(London), 1975.
5. J.W.S. Cassels, An introduction to the Geometry of Numbers, Springer-Verlag (Berlin), 1971.
6. H. Davenport, Multiplicative Number Theory, 2nd edition, Springer-Verlag(New York), 1980.

END SEMESTER EXAMINATION QUESTION PAPER PATTER

Max. Marks: 100 **Exam Duration: 3 Hrs.**

Part A: 6 questions of 4 marks each	24 Marks
Part B: 6 questions of 8 marks each	48 Marks
Part C: 2 questions of 14 marks each	28 Marks

20BSM210P					Programming with Python (Practical)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	---	---	---	50	50	100

Computer program implementing the following concepts will be executed in the laboratory.

Defining Variables, Functions, Display Formats, Saving the variables stored in Memory,

Complex Numbers, Matrices and Vectors, Strings, Input and Output Statements:

MATLAB Programmed output, MATLAB programmed input, Plotting in MATLAB,

MATLAB control flow: IF-END, IF-ELSE-END, ELSE-IF, SWITCH-CASE,

FOR Loops: Single FOR loops, Nested FOR-Loops, Special Case of the FOR Loop, WHILE Loops,

Functions: General Structure of a function, Scope of Variables, Passing Parameters, Global Variables,

The RETURN Statement, Recursive functions.

The basic elements of Python, Branching programs, Strings and Input,

Iteration Functions and Scoping, Specifications, Recursion, Global variables, Modules,

Tuples, Lists and Mutability,

Functions as Objects, Strings, Tuples and Lists, Classes, Inheritance, encapsulation.

20BSM307P					Object Oriented Programming (Practical)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	---	---	---	50	50	100

Computer program implementing the following concepts will be executed in the laboratory.

Writing program in OOP paradigm,

creation of class, encapsulation, objects, member function,

Static member Constructors and destructors,

implementation of constructors, destructors,

Declaration and application of constructors,

Private constructor and Destructors,

program on constructors and destructors,

Inheritance,

Virtual functions and Function overriding,

Polymorphism.