School of Basic Science
Scheme of Studies and Syllabus

CHOICE BASED CREDIT SYSTEM

B. SC. (Hons.) MATHEMATICS

2018-21

SCHEME

Semester – I					
Sr. No.	**Paper Code**	**Subject**	**L-T-P**	**Credits**	
1	BMA-114	Real Analysis	5-1-0	6	
2	BMA-115	Calculus	5-1-0	6	
3	BMA-117	Algebra	5-1-0	6	
4	EN-101A	English Communication (AECC-1)	2-0-0	2	
5	BPH-124	Mechanics	4-0-0	4	
6	BPH-174	Mechanics Lab	0-0-4	2	
7	PDP-101	Induction & Nurturing Hobby	2-0-0	2	
		Total		**28**	

Semester – II					
Sr. No.	**Paper Code**	**Subject**	**L-T-P**	**Credits**	
1	BMA-113	Ordinary Differential Equations	5-1-0	6	
2	BMA-119	Group Theory-I	5-1-0	6	
3	BMA-120	Theory of Real Functions	5-1-0	6	
4	BCH-115	Physical Chemistry (GE-2)	3-1-0	4	
5	CEA-101A	Environmental Science & Ecology(AECC-2)	2-0-0	2	
6	BCH-165	Physical Chemistry Lab	0-0-4	2	
7	PDP-102	Connect People	2-0-0	2	
		Total		**28**	

Semester – III					
Sr. No.	**Paper Code**	**Subject**	**L-T-P**	**Credits**	
1	BMA-222	PDE and systems of ODE	5-1-0	6	
2	BMA-223	Logic and sets(SEC-1)	4-0-0	4	
3	BMA-225	Riemann Integration and series of functions	5-1-0	6	
4	BMA-226	Ring Theory and Linear Algebra-I	5-1-0	6	

5	BCS-201	Web Designing	3-1-0	4	
6	BCS-251	Web Designing Lab	0-0-2	2	
7	BA-2312	Entrepreneurship Development	3-0-0	3	
		Total		**31**	

Semester – IV					
Sr. No.	**Paper Code**	**Subject**	**L-T-P**	**Credits**	
1	BMA-229	Numerical Methods	4-0-0	4	
2	BMA-224	Ring Theory and Linear algebra II	5-1-0	6	
3	BMA-227	Graph Theory (SEC-2)	4-0-0	4	
4	BMA-279	Numerical Methods Lab	0-0-2	2	
5	BA-264A	Managerial Skills (GE-4)	3-0-0	3	
6	PD-293	Intra &Interpersonal Skills	2-0-0	2	
		Total		**21**	

Semester – V					
Sr. No.	**Paper Code**	**Subject**	**L-T-P**	**Credits**	
1	BMA-325	Multi Variate Calculus	5-1-0	6	
2	BMA-326	Group Theory II	5-1-0	6	
3	BMA-329	Metric space and Complex analysis	5-1-0	6	
4	BMA-328	Probability and Statistics(DSE 2)	5-1-0	6	
5	PDP-301	Leadership and Entrepreneurial Development	2-0-0	2	
		Total		**26**	

Semester – VI					
Sr. No.	**Paper Code**	**Subject**	**L-T-P**	**Credits**	
1	BMA-331	Linear Programming (DSE 3)	4-1-0	5	
2	BMA-320	Discrete Mathematics	3-1-0	4	
3	BMA-322	ANALYTICAL GEOMETRY	4-1-0	5	
4	BMA-360	MAT Lab	0-0-4	2	
5	BMA-333	Major project/seminar	4-0-0	4	
		Total		**20**	

Sem 1	**Sem 2**	**Sem 3**	**Sem 4**	**Sem 5**	**Sem 6**	**Total**
28	**28**	**31**	**21**	**26**	**20**	**156**

Lingaya's Vidyapeeth

MATHEMATICS

B.Sc (1st SEMESTER)

Course code	Course title	L	T	P	Credits
BMA-115	**CALCULUS**	5	1	-	6

Course Objectives:
1. Understand the major problems of differential and integral calculus. 2. Appreciate how calculus allows us to solve important practical problems in an optimal way.

UNIT-1: Limit & Continuity :The real line and its geometrical representation; *e*-*δ* treatment of limit and continuity; Properties of limit and classification of discontinuities; Properties of continuous functions.

UNIT-2: Differentiability: Successive differentiation; Leibnitz Theorem; Statement of Rolle's Theorem; Mean Value Theorem; Taylor and Maclaurin's Theorems; Indeterminate forms.

UNIT-3: Applications of Differentiation : Asymptotes; Concavity, convexity and points of inflection; Curvature; Extrema; elementry curves, tangent and normal in parametric form; Polar Coordinates.

UNIT-4: Partial Differentiation: Limits and continuity of functions of two variables; Partial derivatives; Taylor's theorem and Maclaurin's Theorem for function of two variable; Maxima and minima for function of two variable.

UNIT-5: Double and triple integrals; Change of order in double integrals. Application of Integration : length of a curve; Arc length as a parameter; Evoute & Envelope; Volumes and surface areas of solids of revolution.

TEXT BOOKS/REFERENCE BOOKS:

1. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
2. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
3. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar Inc. New York 1975.
4. Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi.
5. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Company, New Delhi.
6. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
7. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus,* 3rd Ed., Dorling Kindersley (India) Ltd. (Pearson Education), Delhi, 2007.
8. H. Anton, I. Bivens and S. Davis, *Calculus,* 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.

Course outcomes:	
1.	Interpret a function from an algebraic, numerical, graphical and verbal perspective and extract information relevant to the phenomenon modeled by the function.
2.	Calculate the limit of a function at a point numerically and algebraically using appropriate techniques including L'Hospital's rule.

Course code	Course title	L	T	P	Credits
BMA-114	REAL ANALYSIS	5	1	-	6

Course Objectives:
1. To describe fundamental properties of the real numbers that lead to the formal development of real analysis. 2. To comprehend rigorous arguments developing the theory underpinning real analysis

UNIT-1: Algebraic and Order Properties of R, d-neighborhood of a point in R. Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness Property of R, The Archimedean Property, Density of Rational (and Irrational) numbers in R, Intervals.

UNIT-2: Limit points of a set, Isolated points,Derived sets, Examples of derived sets, Bolzano-Weierstrass theorem, Illustrations of Bolzano-Weierstrass theorem for sets. Idea of countable sets, uncountable sets and uncountability of R

UNIT-3: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria.

UNIT-4: Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchy's Convergence Criterion.

UNIT-5: Infinite series, convergence and divergence of infinite series, Cauchy Criterion,Tests for convergence: Comparison test, Limit Comparison test, Ratio Test, Cauchy's nth root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

TEXT BOOKS/REFERENCE BOOKS:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.

2. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, Jones & Bartlett, Second Edition, 2010

Course outcomes:	
1.	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.
2.	Demonstrate an understanding of limits and how they are used in sequences, series, differentiation and integration.

Course code	Course title	L	T	P	Credits
BMA-117	**ALGEBRA**	5	1	-	6

Course Objectives:

1) Students should be helped to make connections and build relationships between algebra and arithmetic, geometry, and probability and statistics.
2) The course will enhance research, inquiry and analytical thinking abilities of students.

UNIT-1: Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications.

UNIT- 2: Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

UNIT- 3: Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation AX=B, solution sets of linear systems, applications of linear systems, linear independence.

UNIT -4: Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices.

UNIT - 5: Subspaces of R^n, dimension of subspaces of R^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix, special matrices.

TEXT BOOKS/REFERENCE BOOKS:

1. Titu Andreescu and Dorin Andrica, *Complex Numbers from A to Z*, Birkhauser, 2006.
2. Edgar G. Goodaire and Michael M. Parmenter, *Discrete Mathematics with Graph Theory,* 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005.
3. David C. Lay, *Linear Algebra and its Applications,* 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.

Course outcomes:	
1.	Students will learn to transform between bases, including the creation, geometric connections, and the application of orthogonal and orthonormal bases.

2.	Students will learn Fundamental Theorem of Arithmetic

Course code	Course title	L	T	P	Credits
BPH-124	**Mechanics**	**4**	**0**	**0**	**4**

Course Objectives:
• To acquire skills allowing the student to identify and apply formulas of optics and wave physics using course literature. • To be able to identify and illustrate physical concepts and terminology used in optics and to be able to explain them in appropriate detail. • To be able to make approximate judgments about optical and other wave phenomena when necessary. • To acquire skills allowing the student to organize and plan simpler laboratory course experiments and to prepare an associated oral and written report

Unit-1: Wave Optics-I :

Interference: Interference of light and its necessary conditions, path & Phase difference for reflected & transmitted rays, Interference in thin films (parallel and wedge shaped film), Newton's rings.
Diffraction: Single, double and N- Slit Diffraction, Diffraction grating, Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

Unit-II Fundamentals of Dynamics:

Reference frames. Inertial frames; Galileantransformations; Galilean invariance. Review of Newton's Laws of Motion. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Momentum of variable-mass system: motion of rocket.
Non-inertial frames and fictitious forces. Uniformly rotatingframe. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems.

Unit-III Special Theory of Relativity:

Michelson-Morley Experiment and its outcome.Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum. Energy-Momentum Four Vector.

Unit-IV Work Energy and Collisions:

Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Unit-V Magnetic & Superconducting Properties:

Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material, Applications of Magnetism.
Superconductors: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Temperature dependence of critical field, Type I and Type II superconductors. Applications of Superconductors.

TEXT BOOKS/REFERENCE BOOKS:

- *An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.*
- *Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.*

- *Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.*
- *Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.*
- *Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education*
- *Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.*
- *University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.*

Additional Books for Reference

- *Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000*
- *University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley*
- *Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning*
- *Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.*

Course Objectives:
• To acquire skills allowing the student to identify and apply formulas of mechanics using course literature • To be able to make approximate judgement about waves and mechanics phenomenon when necessary • To acquire skill allowing the student to organize and plan simpler laboratory course and experiments to prepare and associated oral and written report.

Course code	Course title	L	T	P	Credits
BPH-174	**Mechanics**	**0**	**0**	**4**	**4**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine "**g**" and velocity for a freely falling body using Digital Timing Technique
7. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
8. To determine the Young's Modulus of a Wire by Optical Lever Method.
9. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.
12. To determine the value of g using Kater's Pendulum.

Note: Each student is required to perform at least seven experiments.

<u>TEXT BOOKS/REFERENCE BOOKS</u>

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

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MATHEMATICS

B.Sc (2^{nd} SEMESTER)

Course code	Course title	L	T	P	Credits
BMA-113	**ORDINARY DIFFERENTIAL EQUATIONS**	5	1	-	6

Course Objectives:
1) Identify essential characteristics of ordinary differential equations. 2) Develop essential methods of obtaining closed form solutions.

UNIT-1: Geometrical meaning of a differential equation. Exact differential equations, integrating factors. First order higher degree equations solvable for x,y,p Lagrange's equations, Clariaut's equations. Equation reducible to Clariaut's form.

UNIT-2: Orthogonal trajectories: in Cartesian coordinates and polar coordinates. Self orthogonal family of curves.. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Equations reducible to homogeneous .

UNIT-3: Method of variations of parameters. Method of undetermined coefficients. Reduction of order of a differential equation. Linear differential equations of second order: Reduction to normal form.

UNIT-4: Transformation of the equation by changing the dependent variable/ the independent variable. Solution by operators of non-homogeneous linear differential equations.

UNIT-5: Ordinary simultaneous differential equations. Solution of simultaneous differential equations involving operators x (d/dx) or t (d/dt) etc. Simultaneous equation of the form dx/P = dy/Q = dz/R. Total differential equations. Condition for Pdx + Qdy +Rdz = 0 to be exact. General method of solving Pdx + Qdy + Rdz = 0 by taking one variable constant. Method of auxiliary equations.

TEXT BOOKS/REFERENCE BOOKS:

1. B.Rai & D.P. Chaudhary : Ordinary Differential Equations; Narosa, Publishing House Pvt. Ltd.

2. D.A. Murray : Introductory Course in Differential Equations. Orient Longaman (India)

Course outcomes:	
1.	Distinguish between initial value problems and boundary value problems.
2.	Solve standard constant coefficient nonhomogeneous ordinary differential equations by the methods of undetermined coefficients.

Code	Name	Credit (6)
BMA-119	**Group Theory I**	5-1-0

Course Objectives:
1)Students will be able to understand the concept of group theory. 2)Understand the properties of homomorphism and isomorphism.

Unit-1: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups, Groups Acting on Sets.

Unit-2: Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups. Properties of cyclic groups, classification of subgroups of cyclic groups.

Unit-3: Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

Unit-4: External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

Unit-5: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Books Recommended

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002.
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra,* 4th Ed., Narosa Publishing House, New Delhi, 1999.
4. Joseph J. Rotman, *An Introduction to the Theory of Groups,* 4th Ed., Springer Verlag, 1995.
5. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Limited, India, 1975.

Course outcomes:	
1.	Explain the concept of group homomorphism and the application of these concepts
2.	Be able to produce examples and counter examples examples illustrating the mathematical concepts presented in the course.

Course code	Course title	L	T	P	Credits
BMA-120	**Theory of Real Functions**	**5**	**1**	**-**	**6**

Course Objectives:
1)Students will be able to describe fundamental properties of continuous functions that lead to the formal development of real analysis. 2)Appreciate how abstract ideas and regions methods in mathematical analysis can be applied to important practical problems.

Unit-1: Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions.

Unit-2: Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Unit-3: Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem,Intermediate value property of derivatives - Darboux's theorem.. .

Unit-4: Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities.Cauchy's mean value theorem. Taylor's series expansions of , sin (x), e ^x and cos(x).

Unit-5: Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, ln(1 + x), 1/ax+b and $(1 + x)^n$

Books Recommended

1. R. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, John Wiley and Sons, 2003.
2. K.A. Ross, *Elementary Analysis: The Theory of Calculus*, Springer, 2004.
3. A. Mattuck, *Introduction to Analysis*, Prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, *A Course in Calculus and Real Analysis,* Springer, 2006.

Course outcomes:	
1.	Demonstrate an understanding of limits ad how that are used in sequences, series and differentiation.
2.	Construct rigorous mathematical proofs of basic results in real analysis.

Course code	Course title	L	T	P	Credits
BCH-115	**PHYSICAL CHEMISTRY**	3	1	-	4

Course Objectives:

OBJECTIVES:

1. Here in this syllabus we start learning with aspects of thermochemistry and thermodynamics.
2. It become easy to understand the aspect of thermodynamic behavior of chemical reaction and their direct indirect influence on chemical activity after the study.
3. We also learn the theory of Chemical equilibrium and their different aspect of forward and backward reactions.
4. Student may also able to understand the colligative properties of any chemical systems.

UNIT-1: THERMOCHEMISTRY-I:

Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics.

First law: Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.

Unit-II THERMOCHEMISTRY-II

Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

Unit-III SYSTEMS OF VARIABLE COMPOSITION:

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

Unit-IV CHEMICAL EQUILIBRIUM:

Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants K_p , K_c and K_x. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Unit-V SOLUTIONS AND COLLIGATIVE PROPERTIES:

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

TEXT BOOKS/REFERENCE BOOKS:

- Peter, A. & Paula, J. de. *Physical Chemistry 9th Ed.,* Oxford University Press (2011).
- Castellan, G. W. *Physical Chemistry 4th Ed.,* Narosa (2004).
- Engel, T. & Reid, P. *Physical Chemistry 3rd Ed.,* Prentice-Hall (2012).
- McQuarrie, D. A. & Simon, J. D. *Molecular Thermodynamics* Viva Books Pvt. Ltd.: New Delhi (2004).
- Assael, M. J.; Goodwin, A. R. H.; Stamatoudis, M.; Wakeham, W. A. & Will, S. *Commonly Asked Questions in Thermodynamics.* CRC Press: NY (2011).
- Levine, I .N. *Physical Chemistry* 6th Ed., Tata Mc Graw Hill (2010).
- Metz, C.R. *2000 solved problems in chemistry,* Schaum Series (2006)

LEARNING OUTCOMES:

1. On finishing these modules of chemistry we are able to differentiate colligative properties of solution like elevation of boiling point, depression of freezing point with relatively lowering the vapor pressure.
2. Its also easy to understand thermodynamic derivation of relations between the various equilibrium constants K_p , K_c and K_x. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.

Course code	Course title	L	T	P	Credits
BCH-165	**PHYSICAL CHEMISTRY LAB-II**	-	-	4	2

(a) Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).

(b) Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.

(c) Calculation of the enthalpy of ionization of ethanoic acid.

(d) Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.

(e) Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.

(f) Determination of enthalpy of hydration of copper sulphate.

(g) Study of the solubility∆ of benzoic acid in water and determination of H.

Any other experiment carried out in the class.

Course code	Course title	L	T	P	Credits
CEA-101	**ENVIRONMETAL SCIENCE AND ECOLOGY**	2	0	0	2

Course Objectives:
1) The aim of the course is to make everyone aware of environmental issues like continuing problems of pollution, loss of forest, solid waste disposal, and degradation of environment. 2) Issues like economic productivity and national security, global warming, the depletion of ozone layer and loss of biodiversity are other serious concerns before the mankind.

UNIT-1: THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES: Basic definitions related to environment; Scope, vis-à-vis environmental science and environmental engineering; a uses of environmental degradation, atmospheric composition and associated spheres, habitat and climate; objective, goals and principals involved in environmental education, environmental awareness, Environmental ethics, environmental organization and their involvement.

UNIT-2:. NATURAL RESOURCES: Renewable and non-renewable resources; forest resources, over-exploitation, and deforestation / afforestation; water resources, impact of over-utilization of surface and ground water, floods, drought, conflicts over water, dams; mineral resources: dereliction of mines, environmental effects of extracting and using mineral resources; Food resources, modern agriculture and its impact, problem associated with fertilizer and pesticide, water logging, salinity ; energy resources, renewable, non-renewable energy sources, solar energy, wind energy, hydro energy, biomass energy, geothermal energy, nuclear energy and its associated hazards; land as a resource, land degradation, man induced landslides, soil erosion and desertification.

UNIT-3: ECOSYSTEMS: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in the ecosystem, ecological succession, food chains, food webs and ecological pyramids; characteristic features, structure and function of the following ecosystem -forest ecosystem, grassland ecosystem desert ecosystem and aquatic ecosystems.

UNIT-4: BIODIVERSITY AND ITS CONSERVATION: Bio-geographical classification of India; biodiversity at global, national and local levels, India as a mega-diversity nation, hot-spots of biodiversity; value of biodiversity-consumptive use, productive use, social, ethical aesthetic and option values; threats to biodiversity; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

UNIT-5: ENVIRONMENTAL POLLUTION: Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution; solid waste management, e-waste management; disaster management –floods, earthquake, cyclone and landslides.

TEXT BOOK/REFERENCE BOOKS

1. Kaushik, Anubha, and Kaushik, C.P., "Perspectives in Environmental Studies", 4th Edition New Age International Publishers, 2004
2. Agarwal, K.C., "Environmental Biology", 2nd Edition, Nidhi Publ. Ltd., Bikaner, 2001.
3. Bharucha Erach, "The Biodiversity of India", 2nd Edition, Mapin Publishing Pvt. Ltd., 2006.
4. Brunner R. C., "Hazardous Waste Incineration", 1st Edition McGraw Hill Inc., 1989.
5. Clark R.S., "Marine Pollution", 1st Edition Clanderson Press Oxford,1989
6. .Cunningham, W.P., Cooper, T.H. Gorhani, E. & Hepworth, M.T., Environmental Encyclopedia", 2nd Edition, Jaico Publ. House, 2001.
7. De, A. K., "Environmental Chemistry", 2nd Edition, Wiley Eastern, 1989
8. Jadhav, H. and Bhosale, V.M ., "Environmental Protection and Laws", 1st Edition, Himalaya Pub. House, Delhi, 1995.
9. Mckinney, M.L. and Schocl. R.M., "Environmental Science Systems & Solutions", 2nd Edition, Web enhanced edition, 1996.
10. Rao M.N. and Datta, A.K.,"Waste Water Treatment", 2nd Edition, Oxford & IBH Publ.Co., 1987.
11. Sharma B.K., "Environmental Chemistry", 2nd Edition, Goel Publ. House, Meerut, 2001
12. Trivedi R.K. and Goel, P.K., "Introduction to Air Pollution", 2nd Edition, Techno-science Publications, 1996

Course outcomes:	
1.	Understand fundamental terms related to environment and aware of environmental problems
2.	Analyze the complexities of environmental problems and should know remedies available to them and implement them at their own level

B.Sc (3^{rd} SEMESTER)

Course code	Course title	L	T	P	Credits
BMA-222	**PDE and Systems of ODE**	5	1	-	6

Course Objectives:
1.Introduce students to partial differential equations 2.Introduce students to how to solve linear Partial Differential with different methods

Unit-1: Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First-Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations.

Unit 2: Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations. Derivation of Heat equation, Wave equation and Laplace equation.

Unit 3: Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order Linear Equations to canonical forms.

Unit-4: Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form

Unit-5: Homogeneous linear systems with constant coefficients: Two Equations in two unknown functions, The method of successive approximations, the Euler method, the modified Euler method, The Runge-Kutta method.

Books Recommended

1. Tyn Myint-U and Lokenath Debnath, *Linear Partial Differential Equations for Scientists and Engineers,* 4th edition, Springer, Indian reprint, 2006.
2. S.L. Ross, *Differential equations,* 3rd Ed., John Wiley and Sons, India, 2004.
3. Martha L Abell, James P Braselton, *Differential equations with MATHEMATICA,* 3rd Ed.,Elsevier Academic Press, 2004.
4. M. Merkow and J. Breithaupt, *Information Security: Principles and Practices,* Pearson Education, 2006.

Course outcomes:	
1.	Classify partial differential equations and transform into canonical form.
2.	Solve linear partial differential equations of both first and second order.

Course code	Course title	L	T	P	Credits
BMA-223	**Logic and Sets**	3	1	-	4

Course Objectives:
1.)Students will be able to explain the concepts of sets, relations and functions with a counter example. 2.)To understand the difference between tautology and contradiction.

Unit 1: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators.

Unit 2: Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

Unit 3: Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finiteand infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standardset operations. Classes of sets. Power set of a set, Finite and Infinite Sets, Equipotance of Sets, Examples and Properties of Denumerable Sets.

Unit 4: Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections..

Unit 5:Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations with example of congruence modulo relation, Partial ordering relations, nary relations.

Books Recommended

1. R.P. Grimaldi, *Discrete Mathematics and Combinatorial Mathematics*, Pearson Education, 1998.
2. P.R. Halmos, *Naive Set Theory*, Springer, 1974.
3. E. Kamke, *Theory of Sets*, Dover Publishers, 1950.

Course outcomes:	
1.	Students can formalise first-order properties with formulas of predicate logic.
2.	Students can prove simple first-order properties about sets, relations and functions using calculation style reasoning

Course code	Course title	L	T	P	Credits
BMA-225	**Riemann Integration and Series of Functions**	5	1	-	6

Course Objectives:
1)To describe a regular partition of an interval, a Riemann sum for a function on a given interval (including the specific cases of left, right, and mid-point Riemann sums), and how they can be used to approximate area. 2)Compute specific Riemann sums for a function on a given interval.

Unit 1: Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions;

Unit 2: Riemann integrability of monotone and continuous functions, Properties of theRiemann integral; definition and integrability of piecewise continuous and monotone functions.

Unit 3: Intermediate Value theorem for Integrals; Fundamental theorems of Calculus. Improper integrals; Convergence of Beta and Gamma functions.Pointwise and uniform convergence of sequence of functions. Improper integrals of Type-I, Type-II and mixed type.

Unit 4: Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions;Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit 5: Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem. Cauchy criterion and the Weierstrass M-Test for uniform convergence.

Books Recommended

1. K.A. Ross, *Elementary Analysis, The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

2. R.G. Bartle D.R. Sherbert, *Introduction to Real Analysis,* 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
3. Charles G. Denlinger, *Elements of Real Analysis*, Jones & Bartlett (Student Edition), 2011.

Course outcomes:	
1.	Read and interpret an expression in sigma notation as the sum of a series of numbers.
2.	Express Riemann sums for a function f(x) on a given interval using sigma notation, and identify a function and an interval which give rise to a given Riemann sum in sigma notation.

Course code	Course title	L	T	P	Credits
BMA-226	**Ring Theory and Linear Algebra I**	5	1	-	6

Course Objectives:
1.Students will have the capacity to work with the classes of rings and fields appearing in the course, particularly specific calculations around finite fields and polynomials. 2. Be able to produce examples and counter examples illustrating the mathematical concepts presented in the course.

Unit 1:Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Factor rings, Operations on ideals, Prime and maximal ideals.

Unit 2: Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit 3: Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

Unit 4: Vector spaces , subspaces, algebra of subspaces, quotient spaces , linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit 5: Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended:

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., PrenticeHall of India Pvt. Ltd., New Delhi, 2004.
4. Joseph A. Gallian, Contemporary Abstract Algebra, 4th Ed., Narosa Publishing House, New Delhi, 1999.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
6. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.

7. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India,1999.
8. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
9. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

Course outcomes:	
1.	Will be able to write the statements and proofs of important theorems and be able to explain the key steps in proofs, sometimes with variation
2.	Facility with the ring homomorphisms and presentations, and the application of these in order to describe aspects of the intrinsic structure of rings ,both abstractly and in specific examples

Course code	Course title	L	T	P	Credits
BCS-201	**WEB DESIGNING**	**3**	**1**	**0**	**4**

Course Objectives:
1) Understand the principles of creating an effective web page, including an in-depth consideration of information architecture. 2) Become familiar with graphic design principles that relate to web design and learn how to implement these theories into practice.

UNIT – 1 : INTRODUCTION TO INTERNET:

World Wide Web and concepts of website, web pages etc. Client – Server Architecture, The idea of hypertext and hyper media: how the web works: HTTP, HTML and URLs; how the browser works: MIME types, plug-ins and helper applications, standards, Introduction to HTML, XML, XHTML and the W3C.

UNIT – 2 : HYPERTEXT MARKUP LANGUAGE:

HTMLS: The anatomy of an HTML document; marking up for structure and style: basic page markup, ordered and unordered list, Structuring content with HTML using natural divisions, Marquee text with or without background with attributes, Working with Links Internal Links: Anchor Link, Email Link; embedding images, table creation: Table attributes Colspan, Rowspan, Table Border, Align, Valign, Table background image, Nesting tables, Frames and Nesting, iframes, forms, Semantic elements of HTMLS, Media tags in HTMLS.

UNIT – 3 : CASCADING STYLE SHEET:

Introduction to Cascading Style Sheet: Selector, Declaration and declaration block. Types of CSS – Inline and Internal style specifications within HTML; external linked style specification using CSS, page and site design considerations. Types of Selector:Universal, Class and ID Selector, Building & Applying Class Selectors, ID Selector using Div Tags and span tag.

UNIT – 4 : CLIENT SIDE PROGRAMMING:

Introduction to JavaScript syntax: output, Comments, variables, functions, operators, conditions, switch, loop. Java1Script object model: Window, Location and History object model; HTML DOM: Introduction to DOM: methods, event handling, navigation, Forms validation.

UNIT – 5 : TESTING WEB APPLICATION :

Introduction, Fundamentals, Terminology, Quality characteristics, test objectives, test levels, Test Methods and Techniques, Link Testing, Browser Testing, Usability Testing Load, stress and continuous testing; Testing Security; Test automation; Benefits and drawbacks of automation testing.

TEXT BOOKS/REFERENCE BOOKS:

Course outcomes:	
1.	Employ fundamental computer theory to basic programming techniques.
2.	Use fundamental skills to maintain web server services required to host a website.

B.Sc (4th SEMESTER)

Course code	Course title	L	T	P	Credits
BMA-229	**Numerical Methods**	**5**	**1**	**-**	**6**

Course Objectives:

1) Derive appropriate numerical methods to solve algebraic and transcendental equations
2) Develop appropriate numerical methods to approximate a function

UNIT-1. ERRORS AND APPROXIMATIONS, SOLUTION OF NONLINEAR EQUATIONS : Introduction to numbers and their accuracy; absolute, relative and percentage errors. Bisection method; Regular falsi method; secant method; fixed point iteration method; Newton- Raphson method; convergence criteria of methods.

UNIT-2. SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS : Gauss elimination method; Gauss-Jordan method; UV factorization method; Jacobi's iteration method; Gauss-Seidal iteration
method .

UNIT-3. INTERPOLATION AND CURVE FITTING: Introduction to interpolation ; Newton's forward and backward interpolation formulae; Gauss's forward and backward interpolation formulae; Stirling formula; Lagrange interpolation; Newton's divided difference formula; Principle of least squares; curve fitting.

UNIT-4. NUMERICAL DIFFERENTIATION AND INTEGRATION: Numerical differentiation formulae: differentiation by using forward interpolation formula; backward interpolation formula; Stirling formula; Newton-Cotes formula for numerical integration: Trapezoidal rule; Simpson's rules; Boole's rule and Weddle's rule; Romberg' method.

UNIT-5. NUMERICAL SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATION : ,Taylor series method; Euler method; Euler modified method; Runge kutta method;

Milne's predictor -corrector method; Adams-Bashforth method for finding solution of differential equation.

Books Recommended:

1) Grewal, B. S., "Numerical methods in Engineering and Science".

2) M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007

3) Sastry, S.S.," " Introductory Methods of Numerical Analysis".

4) Curtis F "Applied Numerical Analysis".

5) Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.

Course outcomes:	
1.	Solve an algebraic or transcendental equation using an appropriate numerical method
2.	Approximate a function using an appropriate numerical method

Course code	Course title	L	T	P	Credits
BMA-224	**Ring Theory and Linear Algebra II**	5	1	-	6

Course Objectives:
Demonstrate understanding of the idea of a group, a ring and an integral domain, and be aware of examples of these structures in mathematics. Appreciate the significance of unique factorization in rings and integral domains. To learn the basic terminology and results concerning abstract algebra

Unit 1: Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests.

Unit 2: Eisenstein criterion,unique factorization in Z[x]**.** Divisibility in integral domains, irreducibles, primes, uniquefactorization domains, Euclidean domains

Unit 3: Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator

Unit 4: Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal Complements

Unit 5: Bessel's inequality, the adjoint of a linear operator, Least Squares Approximation, minimal solutions to systems of linear equations, Normal and self-adjoint operators, Orthogonal projections and Spectral theorem

TEXT BOOKS/REFERENCE BOOKS:

1. John B. Fraleigh, *A First Course in Abstract Algebra*, 7th Ed., Pearson, 2002**.**
2. M. Artin, *Abstract Algebra*, 2nd Ed., Pearson, 2011.
3. Joseph A. Gallian, *Contemporary Abstract Algebra*, 4th Ed., Narosa Publishing House, 1999.
4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, *Linear Algebra,* 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
5. S. Lang, *Introduction to Linear Algebra,* 2nd Ed., Springer, 2005.
6. Gilbert Strang, *Linear Algebra and its Applications*, Thomson, 2007.

Course outcomes:	
1.	Students completing this course will be able to find the null space of a matrix and represent it

2.	Apply the theory in the course to solve a variety of problems at an appropriate level of difficulty.

Code	Name	Credits(2)
BMA-279	**Numerical Methods Lab**	**0-0-2**

List of Practicals (Using any software)

(1) Bisection Method.

(2) Newton Raphson Method.

(3) Secant Method.

(4) Regulai Falsi Method.

(5) Gauss Elimination.

(6) Gauss-Jacobi Method.

(7) Gauss-Seidal Method.

(8) R-K Method.

(9) Simpson's rule.

(10) Trapezoidal Rule.

11) Rung-Kutta Method

Course code	Course title	L	T	P	Credits
BMA-227	**Graph Theory**	**3**	**1**	**-**	**4**

Course Objectives:
1) It has a aim to know about different types of graph. 2) To understand Shortest Path.

Unit1: Definition, examples and basic properties of graphs, pseudo graphs, complete graphs Adjacency and incidence matrices,.

Unit 2: Bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits Paths, walks, cycles, components, cut-edges, cut-vertices..

Unit-3: Hamiltonian cycles, the adjacency matrix, weighted graph,Characterization, Fleury's algorithm, chinese-postman-problem.

Unit4: Tree, Spanning trees, radius and diameter, Minimum spanning trees (Kruskal's algorithm) ,travelling salesman's problem,shortest path.

Unit 5: Network flow problems, flows and source/sink cuts, Ford-Fulkerson algorithm, Max-flow min-cut theorem. Vertex colorings, bounds on chromatic numbers, Dijkstra's algorithm,Floyd-Warshall algorithm.

Books Recommended :

1. B.A. Davey and H.A. Priestley, Introduction to Lattices and Order, Cambridge University Press, Cambridge, 1990.
2. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 2nd Edition, Pearson Education (Singapore) P. Ltd., Indian Reprint 2003.
3. Rudolf Lidl and Gunter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004

Course outcomes:	
1.	Students will able to learn applications of matrix in graph.
2.	It will help to understand Networking.

B.Sc(H) Mathematics

(V- SEMESTER)

Course code	Course title	L	T	P	Credits
BMA-325	Multivariate Calculus	5	1	-	6

Course Objectives:
The goal of this chapter is to see that many quantities in various scientific fields depend on more than one variable: the strength of the gravitational force between two bodies depend on their masses and their distance apart. The understand how the value of a multivariable function changes as one of its independent variables is allowed to vary with all other variables fixed at constants.

UNIT-1: Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability.

UNIT-2: Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl

UNIT-3 : Double integration over rectangular region, double integration over non-rectangular 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.

UNIT-4: Change of variables in double integrals and triple integrals. Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

UNIT-5: Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

TEXT BOOKS/REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus,* 3rd Ed., Dorling Kindersley (India) Pvt .Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus*, Springer (SIE), Indian reprint, 2005.
4. James Stewart, *Multivariable Calculus, Concepts and Contexts*, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

Course outcomes:	
1.	Handle vectors fluently in solving problems involving the geometry of lines, curves, planes, and surfaces in space.
2.	Visualize and draw graphs of surfaces in space.

Course code	Course title	L	T	P	Credits
BMA-326	**Group Theory II**	**5**	**1**	**-**	**6**

Course Objectives:
1)This lecture course unit aims to introduce students to some more sophisticated concepts and results of group theory as an essential part of general mathematical culture and as a basis for further study of more advanced mathematics. 2)Provide knowledge of some fundamental results and techniques from the theory of finite groups

UNIT-1: Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups.

UNIT-2: Characteristic subgroups, Commutator subgroup and its properties.
Properties of external direct products, the group of units modulo n as an external direct product,internal direct products, Fundamental Theorem of finite abelian groups

UNIT-3: Group actions, stabilizers and kernels, permutation representation associated with a given group action, Applications of group actions: Generalized Cayley's theorem, Index theorem..

UNIT-4: Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn.

UNIT-5: *p*-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for n ≥ 5,non-simplicity tests..

TEXT BOOKS/REFERENCE BOOKS:

1. G.B. Thomas and R.L. Finney, *Calculus*, 9th Ed., Pearson Education, Delhi, 2005.
2. M.J. Strauss, G.L. Bradley and K. J. Smith, *Calculus,* 3rd Ed., Dorling Kindersley (India) Pvt .Ltd. (Pearson Education), Delhi, 2007.
3. E. Marsden, A.J. Tromba and A. Weinstein, *Basic Multivariable Calculus*, Springer (SIE), Indian reprint, 2005.
4. James Stewart, *Multivariable Calculus, Concepts and Contexts*, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

Course outcomes:	
1.	Verify group properties in particular examples
2.	Understand and use the concept of conjugacy

Course code	Course title	L	T	P	Credits
BMA-328	**Probability and Statistics**	4	1	-	5

Course Objectives:
We will study about the Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables. Provide the knowledge about discrete time Markov chain .

Unit 1: Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments

Unit 2: Moment generating function, characteristic function, discrete distributions: uniform, binomial,Poisson, geometric, negative binomial

Unit 3: Continuous distributions: uniform, normal, exponential. Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions.

Unit 4: Expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance(from jmgf), linear regression for two variables.

Unit 5: Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance, Markov Chains, Chapman-Kolmogorov equations, classificationof states

TEXT BOOKS/REFERENCE BOOKS:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education, Asia, 2007.

2. Irwin Miller and Marylees Miller, John E. Freund, *Mathematical Statistics with Applications*, 7th Ed., Pearson Education, Asia, 2006.

3. Sheldon Ross, *Introduction to Probability Models,* 9th Ed., Academic Press, Indian Reprint, 2007.

4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, *Introduction to the Theory of Statistics*, 3rd Ed., Tata McGraw- Hill, Reprint 2007.

Course outcomes:	
1.	How to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions
2.	Discrete time Markov chains and methods of finding the equilibrium probability distributions
3.	How to translate real-world problems into probability models

Course code	Course title	L	T	P	Credits
BMA-329	**Metric Spaces and Complex Analysis**	**5**	**1**	**-**	**6**

Course Objectives:
Students will have been introduced to point-set topology and will know the central importance of complex variables in analysis. Students will have grasped a deeper understanding of differentiation and integration in this setting and will know the tools and results of complex analysis including Cauchy's Theorem, Cauchy's integral formula, Liouville's Theorem, Laurent's expansion and the theory of residues

Unit 1: Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor’s theorem. Subspaces, dense sets, separablespaces

Unit 2: Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem.Connectedness, connected subsets of R.

Unit 3: Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function, derivatives of functions

Unit 4: Definite integrals of functions. Contours ,Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula.Liouville’s theorem and the fundamental theorem of algebra. **]**

Unit 5: Convergence of sequences andseries, Taylor series and its examples.Laurent series and its examples, absolute and uniform convergence of power series

TEXT BOOKS/REFERENCE BOOKS:

1. Satish Shirali and Harikishan L. Vasudeva, *Metric Spaces*, Springer Verlag, London, 2006.
2. S. Kumaresan, *Topology of Metric Spaces*, 2nd Ed., Narosa Publishing House, 2011.
3. G.F. Simmons, *Introduction to Topology and Modern Analysis*, McGraw-Hill, 2004.
4. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications,* 8th Ed., McGraw – Hill International Edition, 2009.
5. Joseph Bak and Donald J. Newman, *Complex Analysis,* 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., NewYork, 1997.

Course outcomes:	
1.	Explain the fundamental concepts of real analysis and their role in modern mathematics and applied contexts
2.	Demonstrate accurate and efficient use of complex analysis techniques.

B.Sc(H) Mathematics (VI- SEMESTER)

Course code	Course title	L	T	P	Credits
BMA-331	**Linear Programming**	**4**	**1**	**-**	**5**

Course Objectives:
Evaluate the computational performance of search, satisfaction, optimization and learning algorithms. Apply search, satisfaction, optimization and learning algorithms to real world problems

Unit 1: Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format.

Unit 2: Introduction to artificial variables, two phase method, Big M method and their comparison. Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual

Unit 3: Transportation problem and its mathematical formulation, northwestcorner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem

Unit 4: Assignment problem and its mathematical formulation, Hungarian method for solving assignment problem

Unit 5: Game theory: formulation of two person zero sum games, solving two person zero sum games, Games with mixed strategies, graphical solution procedure, linear programming solution of games

TEXT BOOKS/REFERENCE BOOKS:

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows,* 2nd Ed., John Wiley and Sons, India, 2004.
2. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research,* 9th Ed., Tata McGraw Hill, Singapore, 2009.
3. Hamdy A. Taha, *Operations Research, An Introduction,* 8th Ed., Prentice-Hall India, 2006.
4. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi, 2002.

Course outcomes:	
1.	Describe at an intuitive level the process of artificial intelligence and operations research: a real-time cycle of problem understanding, formulation, solution and implementation
2.	Formulate simple reasoning, learning and optimization problems, in terms of the representations and methods presented .

Course code	Course Title	L	T	P	Credits
BMA-322	**Econometrics & Statistics**	**4**	**1**	**0**	**5**

Unit-I: Basic Statistics: Statistical Concepts, Partition Values, Quartiles, deciles, percentiles, Measures of variation, Range, IQR, quartile deviation.

Unit-II: Correlation Analysis: Correlation coefficient, Assumption of Correlation analysis coefficient of determination and correlation, Measurement of correlation, Karl person's method, spearman's rank correlation, Concurrent deviation of the correlation coefficient.

Unit-III: Distribution & Estimation of parameter: Random variable, Normal distribution; chi-square, t and F-distributions; estimation of parameters; properties of estimators.

Unit-IV: Hypothesis Testing: Testing of hypotheses: defining statistical hypotheses; distributions of test statistics; testing hypotheses related to population parameters; Type I and Type II errors; power of a test; tests for comparing parameters from two samples.

Unit V: Regression Analysis: Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem; forecasting, Multiple Linear Regression Model Estimation of parameters.

Bo**oks Recommended**

1. Jay L. Devore, *Probability and Statistics for Engineers*, Cengage Learning, 2010.
2. John E. Freund, *Mathematical Statistics*, Prentice Hall, 1992.
3. Richard J. Larsen and Morris L. Marx, *An Introduction to Mathematical Statistics and its Applications,* Prentice Hall, 2011.
4. D. N. Gujarati and D.C. Porter, *Essentials of Econometrics*, McGraw Hill, 4th Ed., International Edition, 2009.

BMA-320	Discrete Mathematics	L-T-P	Credits
		3-1-0	4

UNIT-I Set Theory: Definition of Sets, Venn Diagrams, complements, cartesian products, power sets, counting principle, cardinality and countability (Countable and Uncountable sets), proofs of some general identitites on sets, pigeonhole principle. Relation:Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation. Function: Definition and types of function, composition of functions, recursively defined functions.

UNIT-II Propositional logic: Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction , normal forms(conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification. Notion of proof: proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example.

UNIT-III Combinatories: Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.)

Unit-IV Algebraic Structure: Binary composition and its properties definition of algebraic structure; Groyas Semi group, Monoid Groups, Abelian Group, properties of groups, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields (definition and standard results).

UNIT-V Graphs: Graph terminology, types of graph connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number. Tree: Definition, types of tree(rooted, binary), properties of trees, binary search tree, tree traversing (preorder, inorder, postorder). Finite Automata: Basic concepts of Automation theory, Deterministic finite Automation(DFA), transition function, transition table, Non Deterministic Finite Automata (NDFA), Mealy and Moore Machine, Minimization of finite Automation.

Text/Reference Books:

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Mc.Graw Hill, 2002.

2. J.P.Tremblay & R. Manohar, “Discrete Mathematical Structure with Applications to PDF created with pdfFactory Pro trial version www.pdffactory.com Computer Science” Mc.Graw Hill

3. V. Krishnamurthy, “Combinatories:Theory and Applications”, East-West Press.

4. Seymour Lipschutz, M.Lipson, “Discrete Mathemataics” Tata Mc Graw Hill

Course code	Course title	L	T	P	Credits
BMA-360	**MATLAB**	**0**	**0**	**2**	**2**

Course Objective
Familiarization of the syntax, semantics, data-types and library functions of numerical computing languages such as MATLAB and/or SCILAB, and application of such languages for implementation/simulation and visualization of basic mathematical functions relevant to electronics applications.

NAME OF EXPERIMENT:

1. Draw a 3X3 Matrix and Find its Eigen values and Eigen vectors.

2. Solve the differential Equation $\frac{dy}{dx} = 1 + xy$ by using R.K method of 1st and 2nd order.

3. Solve the differential Equation $\frac{dy}{dx} = \frac{y-x}{y+x}$ by using Euler's Method.

4. Evaluate the function by Newton's forward and backward Interpolation.

X	1	2	3	4	5
Y	1	4	9	16	25

5. If a matrix A=$\begin{matrix} 2 & 2 & 3 \\ 1 & -1 & 0 \\ 3 & 2 & 4 \end{matrix}$ and B=$\begin{matrix} 2 & 1 & 4 \\ -1 & 4 & 0 \\ 3 & 6 & 4 \end{matrix}$ and matrix C is a unit matrix, check by MATLAB (Scilab) Coding i) Distributive law (ii) Associative law

(iii) Commutative law (iv) Addition of 3 matrices (v) AB and BC

6. Solve the system of linear equation

$2x + y - 2z = -2 , 3x - 2y + z = 2, -2x - 2y + 3z = 3$

And find the reduced row echelon form.

7. Solve the differential Equation $f(x) = x^2$ by using Trapezoidal Rule.

8. Solve the differential Equation $f(x) = x^2$ by using Simpson's 1/3rd Rule.

9. Solve the differential Equation $f(x) = x^2 - 2x - 1$ by using Regula Falsi method and Newton Raphson method.

10. Declare the two matrices and find its Addition, Multiplication, and Subtraction and also find the determinant of each matrix.

Course Outcomes
Develop programs in MATLAB Evaluate, analyze and plot results. Perform mathematical Modelling in MATLAB Good understanding of Linear algebra and Signal processing concepts