Maulana Azad National Urdu University

Syllabus

B.Sc. (Mathematics)

Course Title : Calculus **SEM 1**
Course Code : BSMM101CCT

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 4
Instruction Mode : Lecture

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
Exam Duration : 3 Hrs

Course Objectives:
The objective of the course is to introduce concepts of differential and integral calculus and its applications in business, economics, life sciences and physical sciences.

Course Outcomes:
On completion of the course the students will be able to find derivatives & higher order derivatives, solve integrals and will be able to appreciate the beauty, power and versatility of calculus by studying applications in business, economics, life sciences and physical sciences.

Unit	Course Content	Instruction Hours
1	Hyperbolic functions, Higher order derivatives, Leibnitz rule and its applications to the problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital rule, applications in business, economics and life sciences.	15
2	Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \sec^n x\,dx$, $\int (\log x)^n\,dx$, $\int \sin^m x \cos^n x\,dx$.	15
3	Volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.	15
4	Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions, tangents and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law.	15

Examination and Evaluation Pattern :
Continuous evaluation through assignments, projects, internal examinations and semester end examination which can contain multiple choice type questions, problem solving and long answer type questions.

Books Recommended:

1.	Calculus, 9th Ed., Pearson Education, Delhi, 2005	G.B. Thomas and R.L. Finney
2.	Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007	M.J. Strauss, G.L. Bradley and K. J. Smith
3.	Differential Calculus	K. Ahmad
4.	Integral Calculus	K. Ahmad
5.	Differential Calculus- S. Chand	Shanti Narayan
6.	Integral Calculus- S. Chand	Shanti Narayan

Course Title : Calculus Lab **SEM 1**
Course Code : BSMM150CCP

Course Outcomes:
The outcome would be that the students will learn problem solving techniques effectively from the question bank prepared allotted for the practicals for this subject

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 3 hour examination, the students will be tested on their skills in solving problems in calculus followed by a short viva-voce.

Course Title : Differential Equations **SEM 2**
Course Code : BSMM201CCT

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 4
Instruction Mode : Lecture

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
Exam Duration : 3 Hrs

Course Objectives:

The objectives of the course are to train the students to develop an understanding and proficiency in solving 1st and 2nd order Differential Equations and appreciate their applications. The students will learn to find solutions of homogeneous linear differential equations of order 'n' with constant coefficients, solution of non-homogeneous linear differential equations with constant coefficients. The students will understand what is an order & degree of partial differential equations (PDE), concept of linear and non linear PDE and learn method of solving them.

Course Outcomes:

The students will learn the essentials and methods of solving differential equations and PDEs.

	Course Content	Instruction Hours
1	**DIFFERENTIAL EQUATION OF FIRST ORDER AND FIRST DEGREE** Basic concepts- introduction, definitions, formation of a differential equations, Differential equations of first order and first degree, equations in which variables are separable, homogeneous differential equations, differential equations reducible to homogeneous form, linear differential equations, differential equations reducible to linear form, exact differential equations, integrating factors, change of variables.	15
2	**DIFFERENTIAL EQUATIONS OF FIRST ORDER BUT NOT OF FIRST DEGREE** Equations solvable for p, Equations solvable for y, Equations solvable for x, equations that do not contain x(or y), equations of the first degree in x and y - Clairaut's equations. Applications of first order differential equations – Orthogonal trajectories.	15
3	**HIGHER ORDER DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS** Solution of homogeneous linear differential equations of order 'n' with constant coefficients, solution of non-homogeneous linear differential equations with constant coefficients by means of polynomial operators, method of variations of parameters.	15
4	**PARTIAL DIFFERENTIAL EQUATIONS** Order and degree of partial differential equations, concept of linear and non linear partial differential equations, formation of first order partial differential equations, linear partial differential equations of first order, Lagrange's method, Charpit's method.	15

Examination and Evaluation Pattern : Continuous evaluation through assignments, projects, internal examinations and semester end examination which can contain multiple choice type questions, problem solving and long answer type questions.		
Books Recommended:		
1.	Scope as in "Differential Equations and Their Applications"- Prentice hall of India Private Limited, New Delhi	Zafar Ahsan
2.	Ordinary and Partial Differential Equations- S.Chand & Co., New Delhi	Rai Singhania

Course Title : Differential Equations Lab **SEM 2**
Course Code : BSMM250CCP

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 2
Instruction Mode : Lecture

Scheme of Examination
Maximum Score : 50
Internal Evaluation : 15
End Semester : 35
Exam Duration : 2 Hrs

Course Outcomes:
The outcome would be that the students will learn problem solving techniques effectively from the question bank prepared allotted for the practicals for this subject

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 3 hour examination, the students will be tested on their skills in solving problems in Differential equations followed by a short viva-voce.

Course Title : Algebra **SEM 3**
Course Code : BSMM301CCT

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 4
Instruction Mode : Lecture

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
Exam Duration : 3 Hrs

Course Objectives:
The objective of the course is to give an introduction to group theory. The concepts will be introduced with definitions and examples. Proof of certain important results from group theory will be given with mathematical rigour.

Course Outcomes:
This is the first course in Algebra which will expose students to the algebraic formulism and prepare them for more advanced courses in Algebra.

Unit	Course Content	Instruction Hours
1	Binary operations, Definition of groups with examples and its elementary properties, subgroups, Coset decomposition, Lagrange's theorem and its consequences, normal subgroups and factor groups.	15
2	Permutation groups and Cyclic groups-Homomorphism, Isomorphism, kernel of a homomorphism, The homomorphism theorems, The isomorphism theorems **.**Definition and examples of Automorphism, Inner Automorphism, Automorphism Group of finite and infinite Cyclic Groups.	15
3	Rings and their elementary properties, Integral domain, Field. Subrings, Ideals and their properties, Quotient rings. Homomorphism of rings and its properties, Kernel of a homomorphism, Isomorphism and related theorems.	15
4	Rings of polynomials over a field F, Properties of F[X], Rings of Gaussian integers, Rings of polynomials over rational field. Primitive polynomials and their properties. Gauss' Lemma and Eisenstein's criterion for irreducibility.	15

Examination and Evaluation Pattern :
Continuous evaluation through assignments, projects, internal examinations and semester end examination which can contain multiple choice type questions, problem solving and long answer type questions.

Books Recommended:

1.	Contemporary Abstract Algebra- Narosa Publication.	Joseph . A . Gallian
2.	Topics in Algebra- Wiley Eastern Ltd., New Delhi.	I. N. Herstein
3.	Basic Algebra, Volume I and II. -W. H. Freeman and Co.	N. Jacobson
4.	Modern Algebra- Vikas Publication.	Surjeet Singh and Qazi Zameeruddin
5.	University Algebra- New Age International (P) Limited, New Delhi.	NS Gopalakrishan

Course Title : Algebra Lab **SEM 3**
Course Code : BSMM350CCP

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 2
Instruction Mode : Tutorials/Lecture

Scheme of Examination
Maximum Score : 50
Internal Evaluation : 15
End Semester : 35
Exam Duration : 2 Hrs

Course Objectives:

Course Outcomes:
The outcome would be that the students will learn problem solving techniques effectively from the question bank prepared allotted for the practicals for this subject

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 3 hour examination, the students will be tested on their skills in solving problems in Algebra followed by a short viva-voce.

Course Title : Real Analysis **SEM 4**
Course Code : BSMM401CCT

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 4
Instruction Mode : Lecture

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
Exam Duration : 3 Hrs

Course Objectives:
This a core course which introduces students to essential concepts such as Sequences, Series, Limits, Convergence, Continuity and Differentiability. The students will be introduced to the rigour of mathematics and mathematical proofs.

Course Outcomes:
On completion of the course the students will get a strong foundation to understand essential concepts which are necessary for understanding of Calculus, Complex Analysis, Functional Analysis and Topology.

Unit	Course Content	Instruction Hours
1	Algebraic and Order Properties of R, delta-neighbourhood of a point in R, Idea of Countable sets, uncountable sets and uncountability of R. Bounded above sets, Bounder below sets, Bounded Sets, Unbounded sets, Suprema and Infima, The Completeness property of R, The Archimedean Property,	15

	Density of Rational (and irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.	
2	Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Bolzano Weierstrass Theorem for Sequences, Cauchy sequence, Cauchy's Convergence Criterion. Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison tests, Limit Comparison test, Ratio Test, Cauchy's nth root test, integral test, Alternating series, Leibnitz test, Absolute and Conditional convergence.	15
3	Limits and Continuity : Limit of a function – Definition and examples –Theorems. Continuity of a function at a point-Definition and examples – Discontinuity and Types of discontinuities and problems. Algebra of continuous functions-Borel's Theorem – Boundedness property-Maxima –Minima theorem-Intermediate value theorem-Uniform continuity Differentiability of a function at a point and in an interval, Algebra of differentiable functions, Rolle's Theorem , Mean value theorems, related problems, Taylors Theorem, Taylors series and Maclaurin's series expansions of exponential and trigonometric functions.	15
4	Riemann Integration: Inequalities of upper and lower sums, Riemann sums and definition of Riemann integral, theorems of partitions, necessary and sufficient condition of integrability and Riemann integrability of monotone and continuous functions. Properties of Riemann integrals-Fundamental theorem of integral calculus.	15
Examination and Evaluation Pattern : Continuous evaluation through assignments, projects, internal examinations and semester end examination which can contain multiple choice type questions, problem solving and long answer type questions.		
Books Recommended:		
1.	*Introduction to Real Analysis (3rd Edition*), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.	R. G. Bartle and D.R. Sherbert
2.	Principles of Real Analysis - Vikas Publishing House Ltd.	S.L.Gupta and Nisha Rani
3.	*Mathematical Analysis*, New Age International (P) Ltd. Publishers, 1996.	S.C. Malik and Savita Arora
4.	*Mathematical Analysis*, Addison-Wesley Series in Mathematics, 1974.	T.M. Apostol

Course Title : Real Analysis Lab **SEM 4**
Course Code : BSMM450CCP

Scheme of Instruction			**Scheme of Examination**		
Total Duration	:	60 Hr	Maximum Score	:	50
Periods /Week	:	4	Internal Evaluation	:	15
Credits	:	2	End Semester	:	35
Instruction Mode	:	Lecture/Tutorial	Exam Duration	:	3 Hrs

Course Objectives:
The main objective of this course is to teach students how to solve problems related to analysis and through tutorials teach them art of writing proofs of theorems.

Course Outcomes:
The outcome would be that the students will learn problem solving techniques effectively from the question bank prepared allotted for the practicals for this subject.

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 3 hour examination, the students will be tested on their skills in solving problems in Real Analysis followed by a short viva-voce.

Course Title : Linear Algebra **SEM 5**
Course Code : BSMM502DST

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 4
Instruction Mode : Lecture

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
Exam Duration : 3 Hrs

Course Objectives:
The objective of the course is to provide students with a good understanding of the concepts and methods of linear algebra by explaining with examples and related theorems the concept of Vector Spaces, Subspaces, Quotient Space, Linear dependence, Basis and Dimension.

Course outcomes:
On completion of the course students develop the ability to solve problems using linear algebra and will be able to connect linear algebra to other fields both within and without mathematics and will learn a number of applications of linear algebra. Further, the students will be able to develop abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to linear algebra.

Unit	Course Content	Instruction Hours
1	Definition, examples and basic properties of a vector space. Subspaces. Linear combinations and span, Linear independent and linearly dependent vectors- Basis and dimension – related theorems.	15
2	Definition and examples of linear transformations. Properties of linear transformations. Rank and kernel. The rank and nullity of a matrix. Rank-Nullity Theorem and its consequence. The matrix representation of a linear transformation – Related problems.	15
3	Eigenvalues and eigen vectors: Characteristic equation and polynomial. Eigenvectors and eigenvalues of linear transformations and matrices. The Caley-Hamilton Theorem. Similar matrices and diagonalization. Eigenvalues and eigenvectors of symmetric andHermitian matrices. Orthogonal diagonalization. Quadratic forms.	15
4	Inner product vector spaces-Examples-Schwartz, Bessels Inqualilties-Parsevals identity-Gramschimidt Orthogonalization process –Adjoint and other operators on inner product vector space and their related properties.	15

Examination and Evaluation Pattern: Continuous evaluation through assignments, projects, internal examinations and semester end examination which can contain multiple choice type questions, problem solving and long answer type questions.		
Text Books and References:		
1.	*An introduction to Linear Algebra*, East West Press , New Delhi, 2002.	I. V. Krishnamurty, V.P. Mainra, J.L. Arora
2.	Modern Algebra	Surjeet Singh & Q Zameeruddin

Course Title : Linear Algebra Lab **SEM 5**
Course Code : BSMM551DSP

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 2
Instruction Mode : Lecture/Tutorial

Scheme of Examination
Maximum Score : 50
Internal Evaluation : 15
End Semester : 35
Exam Duration : 3 Hrs

Course Outcomes:
The outcome would be that the students will learn problem solving techniques effectively from the question bank prepared allotted for the practicals for this subject

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 3 hour examination, the students will be tested on their skills in solving problems in Linear Algebra followed by a short viva-voce.

Course Title : Numerical Analysis **SEM 6**
Course Code : BSMM602DST

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 4
Credits : 4
Instruction Mode : Counselling

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
Exam Duration : 3 Hrs

Course Objectives:
The objective of the course is to provide students with a good understanding of the concepts and methods of numerical analysis by explaining with examples and related theorems the concept of Numerical Analysis

Course outcomes:
On completion of the course students develop the ability to solve problems of numerical analysis and will be able to connect numerical analysis to other fields both within and without mathematics and will learn a number of applications of numerical analysis.

Unit		Course Content	Instruction Hours
Block I	1	Errors: Relative, Absolute, Round off, Truncation. Transcendental and Polynomial equations	
	2	Solutions of algebraic Equations	
	3	Solutions of Transcendental Equations	
	4	Rate of convergence of these methods	
Block II	5	System of linear algebraic equations- Gaussian Elimination	
	6	Gauss Jordan methods	
	7	Gauss Jacobi method	
	8	Gauss Seidel method and their convergence analysis	
BlockIII	9	Interpolation-Ordinary Finite differences	
	10	Divided Differences, Central Differences	
	11	Lagrange's method, Newton's method.	

	12	Gregory forward and backward difference interpolation	
Block IV	13 14 15 16	Numerical Integration: Trapezoidal rule, Simpson's rule, Simpsons $3/8^{th}$ rule, Boole's Rule. Composite Trapezoidal rule, Composite Simpson's rule. Ordinary differential Equations: Euler's method. Runge-Kutta methods of orders two and four	

Examination and Evaluation Pattern:

Continuous evaluation through assignments, projects, internal examinations and semester end examination which can contain multiple choice type questions, problem solving and long answer type questions.

Text Books and References:

1.	*An introduction to Linear Algebra*, East West Press , New Delhi, 2002.	I. V. Krishnamurty, V.P. Mainra, J.L. Arora
2.	Modern Algebra	Surjeet Singh & Q Zameeruddin

Books Recommended

1. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
2. M. K. Jain, S.R.K Iyengar and R.K. Jain, Numerical Methods for scientific and Engineering Compuatation, 6^{th} Ed., New age International Publisher, India, 2007.
3. C.F Gerals and P.O Wheatley, jApplied Numerical Analysis, Pearson Education, Idia, 2008.
4. Uri M. Ascher and Chen Greif, A First Course in numerical Methods, 7^{th} Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Find, Numercal Methods using Matlab, 4^{th} Ed., PHI Learning Private Limiteed , 2012.

Course Title : Numerical Analysis Lab **SEM 6**
Course Code

Scheme of Instruction			**Scheme of Examination**		
Total Duration	:	60 Hr	Maximum Score	:	50
Periods /Week	:	4	Internal Evaluation	:	15
Credits	:	2	End Semester	:	35
Instruction Mode	:	Lecture/Tutorial	Exam Duration	:	3 Hrs

Course Outcomes:
The outcome would be that the students will learn problem solving techniques effectively from the question bank prepared allotted for the practical's for this subject

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 3 hour examination, the students will be tested on their skills in solving problems in Numerical Analysis followed by a short viva-voce.