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

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

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

Course Objectives:
The objective of the lab is to teach students the use of computers to solve problems in Calculus and its applications. The students will be taught either MATLAB or Open source software - OCTAVE and GNUPLOT for the above purpose.

Course Outcomes:
The outcome would be that the students will learn effective use of computer in solving problems from calculus.

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 2 hour examination, the students will be tested on their skills in utilising the software lab 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 : 3
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 Objectives:
The objective of the lab is to teach students the use of computers to solve differential equations and PDEs using numerical techniques and computers. The students will be taught either MATLAB or Open source software - OCTAVE and GNUPLOT for the above purpose.

Course Outcomes:
The outcome would be that the students will learn numerical techniques and use of computers to solve problems from calculus.

Examination and Evaluation Pattern :
The students will have to submit the Lab record book. At the end of the semester, through a 2 hour examination, the students will be tested on their skills in utilising the software lab in solving problems in calculus followed by a short viva-voce.

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

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
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:

The students will be introduced to GeoGebra, a dynamic mathematics software for education that joins geometry, algebra, and calculus. The objective of the lab is to introduce the connect between algebra & geometry.

Course Outcomes:

On completion of the course the students will be able to appreciate the Geometry-Algebra connect.

Examination and Evaluation Pattern :

The students will have to submit the Lab record book. At the end of the semester, through a 2 hour examination, the students will be tested on their skills in utilising the software lab in solving problems followed by a short viva-voce.

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

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
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, Density of Rational (and irrational) numbers in R, Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.	15
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	15

	value theorems, related problems, Taylors Theorem, Taylors series and Maclaurin's series expansions of exponential and trigonometric functions.	
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
Total Duration : 60 Hr
Periods /Week : 3
Credits : 2
Instruction Mode : Lecture/Tutorial

Scheme of Examination
Maximum Score : 100
Internal Evaluation : 30
End Semester : 70
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 students will be able to construct proofs of theorems and solve problems.

Examination and Evaluation Pattern:
The students will have to submit the Lab record book. At the end of the semester, through a 2 hour examination, the students will be tested on their understanding & skills in solving problems followed by a short viva-voce.

Course Title : Multivariate Calculus (DSE) **SEM 5 Course Code : BSMM501DST**

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
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 this course is to introduce to students concepts of calculus for multivariate functions. To teach them concepts of limit and continuity for functions of multiple variables, and teach them concepts of Line Integral and Surface Integrals and their applications.

Course Outcomes:
On completion of the course students will be able to solve differential and integral equation for functions of multivariable and solve Line Integrals and Surface integrals which are essential for solving problems in varied areas of mathematics such as Fluid Mechanics and dynamical systems.

Unit	Course Content	Instruction Hours
1	Functions of two or more variables, limit and continuity of functions of two variables, Partial Derivatives, Differentiability, Differentials and Local Linearity.	
2	Chain rule for one and two independent parameters, directional derivatives, the gradient, tangent planes and Normal Vectors, Maxima and Minima of functions of two variables, method of Lagrange multipliers	
3	Double Integrals, Double Integrals over non-rectangular regions, Double integrals in polar co-ordinates, surface Area; Parametric surfaces, Triple integrals, Triple integrals in cylindrical and Spherical Coordinates, Change of variables in Multiple integrals; Jacobian	
4	Vector fields, Line Integrals, Independence of Path; Conservative Vector Fields, Green's Theorem, Surface Integrals, Applications of Surface Integrals; Flux, The Divergence Theorem, Stoke's Theorem	

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 10th Ed., Wiley, 2015.	Howard Anton, IRL Bivens and Stephens Davis
2.	Calculus, 9th Ed., Pearson Education, Delhi, 2005	G.B. Thomas and R.L. Finney
3.	Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001	James Stewart

Course Title : Multivariate Calculus Lab **SEM 5**
Course Code : BSMM550DSP

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
Credits : 2
Instruction Mode : Lecture

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

Course Objectives:
Using the open source software OCTAVE the students will learn to visualise functions of many variable, plot surfaces and find numerical solution of differential and integral calculus.

Course Outcomes:
On completion of the course the students will be able to plot functions of single and multiple functions, visualise surfaces and find numerical solutions for differential and integral equations.

Examination and Evaluation Pattern:
The students will have to submit the Lab record book. At the end of the semester, through a 2 hour examination, the students will be tested on their skills in utilising the software lab in solving problems followed by a short viva-voce.

Course Title : Linear Programming (DSE) **SEM 5**

Course Code : BSMM601DST

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
Credits : 4
Instruction Mode : Lecture

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

Course Objectives:
Linear programming is a collection of tools and techniques that are used to solve problems of allocating scarce resources between competing activities in order to maximize or minimize some numerical quantity, such as contribution or costs. The objectives of this course are to introduce to students the tools and techniques of linear programming to solve problems of minimising and finding optimum solutions for various problems from economics and sciences.

Course Outcomes:
On completion of the course the students will learn various algorithms and graphical techniques to find optimum solutions to problems from diverse areas.

Unit	Course Content	Instruction Hours
1	Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method, Big-M method and their comparison.	15
2	Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.	15
3	Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.	15
4	Games 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.	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	Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.	Mokhtar S. Bazaraa, John J. Jarvis and Hanif B. Sherali
2	Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009.	F.S. Hillier and G.J, Lieberman
3	Operations Research, An Introduction, 8th Ed., Prentice-Hall India, 2006.	Hamdy A. Taha
4	Linear Programming, Narosa Publishing House, New Delhi 2002.	G. Hadley

Course Title : Linear Programming Lab **SEM 5**
Course Code : BSMM650DSP

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
Credits : 2
Instruction Mode : Lecture

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

Course Objectives:
The objective is to teach students through tutorial and use of computers to formulate and solve problems from diverse fields and appreciate the power of linear programming.

Course Outcomes:
On completion the students will be able to formulate problems and solve them.

Examination and Evaluation Pattern:
The students will have to submit the Lab record book. At the end of the semester, through a 2 hour examination, the students will be tested on their skills in utilising the software lab in solving problems followed by a short viva-voce.

Course Title : Probability and Statistics **SEM 6**
Course Code : BSMM602DST

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
Credits : 4
Instruction Mode : Lecture

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

Course Objectives:
This course is designed to teach students the basics of statistics, such as measures of central tendency and dispersion and introduce the principles of probability and its application. Concept of Random sample, Probability, Conditional probability will be explained with examples. Baye's theorem and its implications will be discussed. Introduction to various discrete and continuous random variables, sampling theory will be given. Formulation of Null and Alternative hypothesis, tests on small and large samples explained with examples from diverse disciplines. Various statistical distributions such as Normal and Binomial will be taught.

Course outcomes:
By the end of this course students should be able to understand the common statistical techniques and terminology; the students will understand the basic principles of probability and their application and get familiar with the common probability distributions.

Unit	Course Content	Instruction Hours
1	**Measures of central tendency & Measures of Dispersion** Measures of central tendency – Mean, Median, Mode. Measures of Dispersion, Skewness and Kurtosis – Dispersion, Measures of Dispersion – Range, Quartile Deviation, Mean Deviation, Standard Deviation, Root Mean Square Deviation. Variance, Moments, Skewness and Kurtosis.	15
2	**Theory of Probability** Combinatorial analysis -Fundamentals of Permutations and Combination, Random variables, Random experiments, Classical definition and calculation of Probability, Sample spaces, Conditional probability, Theorems on Probability- Multiplication theorem of Probability, Baye's theorem, Central limit theorem.	15
3	**Probability distribution functions** Introduction to various discrete and continuous random variables. Distribution function- Binomial distribution, Bernoulli distribution, Binomial Distribution, Probability Generating Function of Binomial Distribution, Fitting of Binomial	15

	Distribution, Poisson distribution, Moments of Poisson distribution, Mode of Poisson Distribution, Normal Distribution, Normal distribution as a Limiting form of Binomial distribution.	
4	Sampling Theory – Types of sampling, Tests of significance, Null and Alternative hypothesis, Errors in sampling, Critical Region and Level of Significance, One-tailed and Two-tailed tests, Tests on large samples and on small samples. The t-distribution.	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	Fundamentals of Mathematical Statistics	S.C Gupta and V.K. Kapoor.
2	An Introduction to Statistical Methods	C B Gupta and Vijay Gupta.
3	Handbook of Applied Statistics (Willey).	Chakravarthy, I.M.
4	Introduction to Probability Theory and its Applications (Willey - Eastern).	Feller, W

Course Title : Probability and Statistics Lab **SEM 6**
Course Code : BSMM651DSP

Scheme of Instruction
Total Duration : 60 Hr
Periods /Week : 3
Credits : 2
Instruction Mode : Lecture

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

Course Objectives:
The main objective of this course is to train students, through tutorials, problem solving and teach them the versatility and importance of statistics.

Course Outcomes:
The students will be able to solve problems and study applications of statistic and probability in various disciplines such physical sciences, biological sciences and economics and business management.

Examination and Evaluation Pattern:
The students will have to submit the record book. At the end of the semester, through a 2 hour examination, the students will be tested on their skills in solving problems followed by a short viva-voce.