FIRST SEMESTER SYLLABUS

M. Sc. MATHEMATICS

BABA GHULAM SHAH BADSHAH UNIVERSITY RAJOURI, J&K, INDIA

COURSE SCHEME

COURSE CODE	COURSE TITLE	NO. OF CREDITS	DISTRIBUTION OF MARKS		
			SA	UE	TOTAL
MS - 131	Topology and its Applications	4	40	60	100
MS - 132	Techniques in Differential Equations	4	40	60	100
MS - 133	Real Analysis	4	40	60	100
MS - 134	Applied Numerical Analysis	4	40	60	100
MS - 135	Computer Fundamentals and C- Programming	4	40	60	100
MS - 136	Set Theory	2	20	30	50
MS - 137	Lab Course on MS-135	2	25	25	50
	TOTAL	24	245	355	600

SA: Sessional Assessment
UE: University Examination

SEMESTER - I

Course Title	Topology and its Applications	Maximum Marks	100
Course Code	MS-131	University Examination	60
Credits	4	Sessional Assessment	40
		Duration of Exam.	3 HOURS

Objectives ………………		The aim of this course is to introduce the students the basic ideas of metric and topological spaces and make them appreciate their applications.
UNIT 01	Elements of point set topology in Rn	Euclidean norm and its properties – Cauchy Schwartz and Minkowski inequality; open and closed balls; accumulation and interior points of a set; Open and closed sets; Bolozano- Weirstrass theorem(BWT); Cantor intersection theorem(CIT); Lindelof covering theorem(LCT); Heine Borel theorem(HBT) and its converse; compactness.
UNIT 02	Metric and topological spaces	Definition and standard examples of metric spaces; point set topology in metric spaces; Failure of BWT, CIT, LCT and HBT in a general metric space; error correcting codes – Hamming distance; DNA sequences; Topological space(TS); Basis and sub - basis of a Topology; equivalent basis; first and second countable spaces.
UNIT 03	Closure and interior of a set	Closed sets in a topological space; closure and interior of a set in a topological space with their basic properties; dense and no - where dense sets; separable topological spaces; standard bounded metric; relation between separable metric and second countable spaces; separation of disjoint closed sets by disjoint open sets in a metric space.
UNIT 04	Convergence and continuity	Convergent sequences in a TS; Hausdorff space; connection between closure and convergence; Cauchy sequences in a metric space; complete metric spaces - Rn, C[a, b] , little lp spaces ($1 \le p \le \infty$); topological spaces of first and second category; Baire's category theorem; continuity of a function in a TS; relation between continuity and inverse images of open/closed sets and convergence of sequences; homeomorphism.
UNIT 05	Subspaces and connectedness	Sub-space topology; open and closed sets in subspaces; hereditary topological properties; pasting lemma; product of two topological spaces and continuity of projections; Connected, path connected spaces and their continuous images; arbitrary union and finite product of connected spaces; totally disconnected spaces; connectedness of n - dimensional Euclidean space; general version of intermediate theorem; applications to population model.

COURSE OUCOMES

On successful completion of this course, we expect that a student

1. Should be able to explain the concepts of norm, open and closed balls, interior and accumulation points, open, closed and compact sets and fundamental theorems such as BWT, CIT, LCT, HBT in
2. Should be able to explain the concepts of Metric and Topology on a set with their standard examples failure of BWT, CIT, LCT and HBT in general metric spaces.
3. Should be able to explain the concepts of basis and sub – basis of a topological space and first and second countable spaces.
4. Should be able to explain the concepts of interior and closure of set and separable topological spaces along with their connection with first and second countable spaces
5. Should be able to explain the concepts of convergent and Cauchy sequences, in particular in the spaces Rn, c[a, b] and lp spaces and Baires category theorem
6. Should be able to explain the concept of Continuity with its various versions in Topological spaces.
7. Should be able to explain the concept of sub-space topology and various hereditary topological properties.
8. Should be able to explain the concepts of connected, path connected and totally disconnected spaces along with the general version of intermediate theorem.
9. Should be able to appreciate the applications of topology to error correcting codes, DNA sequences and population model.

Note for Paper Setting

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

BOOKS RECOMMENDED

TEXT BOOKS

1. **Apostol, Tom M., (2002),** Mathematical Analysis, 1st edition, **Narosa Publishing House.**

2. **Patty, C.W. (2010),** Foundations of Topology, second Edition, Jones and Barlet.

REFERENCE BOOKS

1. **Adams, C. and Franzosa, R. (2009),** Introduction to Topology – Pure and Applied, **Pearson.**

2. **Munkers, J.R. ,(2000),** Topology, 2nd Edition, **PHI.**

3. **Searcoid, M. O., (2007),** Metric Spaces, **Springer.**

4. **Willard, S., (1976),** General Topology **(1970), Dover Publications New York.**

SEMESTER - I

Course Title	Techniques in Differential Equations	Maximum Marks	100
Course Code	MS-132	University Examination	60
Credits	4	Sessional Assessment	40
		Duration of Exam.	3 HOURS

Objectives ………………..		The main objective of this course is to introduce students to the techniques of solving various differential equations.
UNIT 01	Higher order linear differential equations-I	Basic existence theorem (Proof not included); basic theorems on linear homogenous equations; concept of Wronskian; reduction of order method; general solution of a homogeneous linear differential equation with constant coefficients.
UNIT 02	Higher order linear differential equations-II	Method of undetermined coefficients; method of variation of parameters; Cauchy–Euler equation; power series about an ordinary point; singular point; method of Frobenius; Bessel's equation and Bessel's functions.
UNIT 03	Systems of linear differential equations	Types of linear systems; differential operator; operator method for linear systems with constant coefficients; basic theory of linear systems in normal form; matrix method of solving homogenous linear system with constant coefficients.
UNIT 04	Laplace transform	Definition, examples and basic properties of Laplace transform; existence of Laplace transform; step function; inverse Laplace transform and convolution theorem; solution of linear differential equations with constant coefficients by using Laplace transform; linear systems.
UNIT 05	Sturm-Liouville boundary value problems	Sturm-Liouville problems; characteristic values; characteristic functions; orthogonality of characteristic functions; expansion of a function in a series of orthogonal functions; expansion problem; trigonometric Fourier series and its convergence.

COURSE OUCOMES

On successful completion of this course, we expect that a student

1. The concept of homogeneous and non-homogeneous linear differential equations and the method of finding its general solution.
2. How to find the power series solution of homogeneous differential equations at singular points and ordinary points.
3. How to find the solution of linear system by operator method.
4. The basic theory of linear system of differential equations in normal form & matrix method for solving homogeneous linear system with constant coefficients.
5. The concept of Laplace transform &its basic properties.
6. How to find the solution of linear differential equation by using Laplace transform.
7. The concept of sturm- Liouville problem, orthogonalitiy of characteristic functions & expansion of functions in a series of orthogonal functions.
8. The concept of trigonometric Fourier series and its convergence.

Note for Paper Setting

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

BOOKS RECOMMENDED

TEXT BOOKS

1. **Ross, S., (1984)**, Differential Equations, 3rd Edition, **Wiley India (P) Ltd, New Delhi.**

REFERENCE BOOKS

1. **Boyce,W. E., DiPrima, R.C., (2007),** Elementary Differential Equations and Boundary Value Problem, 8th edition, **John wiley and sons.**

2. **Edward, P., (2005),** Differential Equation and Boundary Value Problems; Computing and Modeling, 3rd edition, **Pearson Education**.

3. **Simmons, G. F., (2003),** Differential Equation with Applications and Historical Notes, 2nd edition, **Tata McGraw Hill edition.**

SEMESTER - I

Course Title	Real Analysis	Maximum Marks	100
Course Code	MS-133	University Examination	60
Credits	4	Sessional Assessment	40
		Duration of Exam.	3 HOURS

Objectives	The objective of this course is to introduce students to Riemann and Lebesgue Integration, and make them learn the convergence issues of sequences and series of functions.
UNIT 01 Riemann Integral	Upper and lower sums; Riemann integral and basic criterion for its existence; basic properties of Riemann integral; connection of monotonicity and continuity with the existence of Riemann integral; fundamental theorem of calculus.
UNIT 02 Sequences and Series of Functions	Point-wise and uniform convergence; Cauchy criterion for uniform convergence; Weierstrass M-test; connection of uniform convergence with differentiation, integration and continuity; example of a continuous and nowhere differentiable function; Weirstrass approximation theorem
UNIT 03 Functions of Bounded Variation	Functions of bounded variation and their sum, difference and product; total variation; additive property of total variation; total variation on [a,x] as a function of x. Continuous functions of bounded variation; rectifiable paths and arc length; additive and continuity properties of arc length; change of parameter.
UNIT 04 Outer Measure & Measureable functions	Outer measure; outer measure of an interval in IR; measureable sets, Lebesgue measure; Borel sets, Non-measureable sets. Measureable functions and their sum, difference and product; sequence of measureable functions; the concept of almost everywhere.
UNIT 05 Lebesgue Integration	Integral of a simple function; integral of a bounded measureable function; connection between Riemann and Lebesgue integral; bounded convergence theorem; Integral of a non-negative function; Fatou's Lemma; monotone convergence theorem; Lebesgue integral of general function; Lebesgue convergence theorem.

COURSE OUCOMES

On successful completion of this course, we expect that a student

1. Explain upper & lower sums, Upper & lower integral & hence Riemann integral.
2. Develop the basic criterion for the existence of Riemann integral and connection between the existence of Riemann integral with monotonicity & continuity.
3. Differentiate between point wise & uniform convergence of sequences & series of functions.
4. Elaborate Cauchy criterion for uniform convergence of sequences & series of functions & hence connection of uniform convergence with differentiation integration & continuity.
5. Explain the concept of functions of bounded variation and total variation.
6. Explain the concepts of measurable sets, measurable functions with their basic properties.
7. Describe the integral of a measureable function with their properties.
8. Explain the fundamental theorems such as Fatou's lemma, monotone convergence theorem, Lebesgue convergence theorem etc.

Note for Paper Setting

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

BOOKS RECOMMENDED

TEXT BOOKS

1. **Bilodeau, G. G., Thie, P. R. and Keough, G.E (2010),** An Introduction to Analysis**, second edition, Joes and Bartlett Learning.**

2. **Yeh, J., (2000),** Lectures on Real Analysis**, World Scientific.**

REFERENCE BOOKS

1. **Denlinger, C. G. (2011),** Elements of Real Analysis**, First Indian edition, Joes and Bartlett Learning.**

2. **Rudin, W., (1976),** Principles of Mathematical Analysis, 3rd edition, **McGraw Hill International Edition**.

3. **Royden, H.L., (2006),** Real Analysis, **3rd edition**, **Prentice-hall of India Private Limited**

SEMESTER - I

Course Title	Applied Numerical Analysis	Maximum Marks	100
Course Code	MS-134	University Examination	60
Credits	4	Sessional Assessment	40
		Duration of Exam.	3 HOURS

Objectives …..................		The aim of this course is to train students in numerical analysis techniques and their applications.
UNIT 01	Error analysis and solutions of non-linear equations	Binary and machine numbers; computer accuracy; computer floating point numbers; errors and their propagation; order of approximation; method of fixed point iteration for solving non-linear equations; Bisection method of Bolzano; method of false position; initial approximation and convergence criteria.
UNIT 02	Solutions of non-linear equations continued	Slope method for finding roots; Newton-Raphson theorem; Secant method; Aitken's process; Jacobian; Siedel and Newton's method for system of non-linear equations.
UNIT 03	Interpolation and polynomial approximation	Taylor series and calculations of functions; Horner's method for evaluating a polynomial; interpolation, Lagrange's approximation, error terms and error bounds for Lagrange's interpolation; Newton polynomials; divided differences; Pade approximation
UNIT 04	Curve fitting	Least square line; power fit method; data linearization; non-linear least squares method; least squares parabolas; Polynomial niggles; interpolation; piece wise cubic splines; existence and construction of cubic splines clamped; parabolic terminates and end point curvature adjusted spline; minimum property of cubic splines; Bernstine and their properties; Bezier curves.
UNIT 05	Numerical differentiation and integration	Approximation of derivative; central differentiation formulas; error analysis and step size; Richardson extrapolation; differentiation of Lagrange's and Newton polynomials; Newton-Cotes quadrature formulae; composite Trapezoidal and Simpson's rules and their error analysis ; recursive trapezoidal and Simpson's rules; Boole rules; Romberg Integration; adoptive curvature; Gauss - Legender integration.

COURSE OUCOMES

On successful completion of this course, we expect that a student

1 Solve algebraic transcendental equation using an appropriate numerical method.

2 Approximate a function using an appropriate numerical method.

3 explain how to fit experimental data into different curves.

4 explain the concept of Spline, Bernstein's Polynomials and Bezier curve.

5 Perform an error analysis for a given numerical method.

6 explain central differentiation formulas, Richardson's extrapolation, differentiation of Lagrange's and Newton's polynomials.

7 Explain Newton's cotes quarantine formulae such as, Trapezoidal, Simpson's rules, Boole's rules, Romberg integration and their error analysis.

Note for Paper Setting

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

BOOKS RECOMMENDED

TEXT BOOKS

1. **Curtis, F. G. and Patrick, O. W., (1999),** Applied Numerical Analysis, 6th edition, **Pearson Education.**

2. **John, H. M. and Kurtis, D. F., (2007),** Numerical Methods using Matlab, 4th edition, **Prentice Hall of India Pvt. Limited, New Delhi.**

REFERENCE BOOKS

1. **Burden, R. L. and Faires, J. D.,(2009),** Numerical Analysis, 7th edition, **CENAGE Learning India (Pvt) Ltd.**

2. **Golub, G. and Loan, C. V., (1996),**Matrix Computations,3rd edition, **John Hopkins University Press.**

3. **Jain, M.K., Iyenger, S.R.K. and Jain, R.K., (2007),** Numerical Methods for Scientific and Engineering Computation, 5th edition, **New Age International Publication, New Delhi.**

SEMESTER - I

Course Title	Computer Fundamentals and C-Programming	Maximum Marks	100
Course Code	MS-135	University Examination	60
Credits	4	Sessional Assessment	40
		Duration of Exam.	3 HOURS

Objectives …....................		The aim of this course is to create awareness among students about computer applications and programming through C-language that will enable them to solve mathematical models.
UNIT 01	Computer fundamentals	Block diagram of computer; characteristics of a computer; generation of computers; I/O devices; memory and its types; number system & conversions; disk operating system (DOS); working with DOS commands (Internal and External).
UNIT 02	Introduction to windows	Customize desktop; working with folders; add printer; add &removing programs; working with word pad; fundamentals of MS-word; creating and formatting MS-word documents; creating &customizing tables; mail merge and using math equations; overview of MS-Excel; working with cells; creating and formatting worksheets; working with formulae bar; creating charts.
UNIT 03	Programming languages	Introduction; history of C language; structure of C program; variables, constants, keywords, operators and data types in C; decision making statements– (if, if else, else if ladder, nested if, switch–case, break, continue, goto).
UNIT 04	Array and function	Loops in C; arrays (one dimensional and multidimensional arrays);string array; introduction to function-element of user-defined function (declaration, function calling, function definition);functions call by value & call by reference; recursive function.
UNIT 05	Structure and pointer	Definitions; declaration structure variable; accessing structure members; array of structures; introduction to pointers-accessing the address of variables; declaration pointer variables; initialization of pointer variable; pointer arithmetic.

COURSE OUCOMES

On successful completion of this course, we expect that a student

1 should be able to explain the concepts of input and output devices of computer and their working.

2 should know the uses of different types of worksheets like WordPad, MS- office and excel sheet.

3 should be able to design programs connecting decision structures, loops and functions.

4 should be able to explain the difference between call by value and call by address.

5 should be able to explain the dynamic behavior of memory by the use of pointers.

Note for Paper Setting

The question paper will be divided into two sections. Section A will be compulsory and will contain 10 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will contain 10 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 10 marks.

BOOKS RECOMMENDED

TEXT BOOKS

1. **Balaguruswamy, E., (2004),** Programming in ANSI C, 4th edition, **Tata McGraw Hill**.
2. **Saxena, S., (2007),**MS- Office for Everyone, 1st edition, **Vikas Publications, New Delhi**.
3. **Sinha, P.K., (2007),** Computer Fundamentals, 4th edition, **BPB Publications, New Delhi**.
4. **Taxali, R.K., (2007),**PC Software for Windows, 1st edition, **TMH, New Delhi.**

REFERENCE BOOKS

1. **Basandra, K., (2008),** Computers Today, 1st edition, **Galgotia publication, New Delhi**.
2. **Schiltz, H.,(2004),** C: The Complete Reference,4th edition**, Tata McGraw Hill.**

SEMESTER - I

Course Title	Set Theory	Maximum Marks	50
Course Code	MS-136	University Examination	30
Credits	4	Sessional Assessment	20
		Duration of Exam.	2 HOURS

Objectives …....................		The aim of this course is to introduce the students with the ideas of advanced set theory.
UNIT 01	Countability of sets	Sets, relations, functions and their basic properties; definitions, examples and properties of finite, countable and uncountable sets
UNIT 02	Cardinal and Ordinal numbers	Cardinal number; arithmetic of cardinal numbers; Cantor's theorem; the cardinality of the continuum; ordinal numbers; arithmetic of ordinal numbers.
UNIT 03	Order Relations and axiom of choice	Partially ordered, well ordered and Totally ordered sets; Order Isomorphism, principle of transfinite induction, Maximal and minimal elements, Zorn's Lemma, Axiom of choice and its equivalent forms.

COURSE OUCOMES

On successful completion of this course, we expect that a student

1 Explain the basic difference between finite, infinite, countable, uncountable sets and their various properties.

2 Explain the arithmetic of cardinal and ordinal numbers.

3 Explain the concept and examples of well ordered sets.

4 Explain axiom of replacement and transfinite induction and recursion.

5 Explain the axiom of choice and its various equivalent forms.

Note for Paper Setting

The question paper will be divided into two sections. Section A will be compulsory and will contain 06 very short answer type questions eliciting answers not exceeding 20 words/ multiple choice questions/ fill in the blanks, each carrying one mark equally distributed from all units. Section B will contain 06 long answer type questions, two from each unit and the candidate will be required to answer one from each unit. Each question carries 08 marks.

BOOKS RECOMMENDED

TEXT BOOKS

1. **Lin You Feng, Schu Yeng, (1981),** Set Theory with Applications**, Second edition, Mariner Publishing Company.**

REFERENCE BOOKS

1. **Hrbalek, K. and Jech, T.,(1999),** Introduction to set theory,3rd edition, **Marcel Dekker, Ind.**

2. **Halmos, P., (2011),** Naïve set theory, **Martino Fine Books.**

SEMESTER - I

Course Title	Lab course on MS-135	Maximum Marks	50
Course Code	MS-137	University Examination	25
Credits	2	Sessional Assessment	25
		Duration of Exam.	2 HOURS

Objectives …..................

* Each student is required to maintain a practical record book.
* Two practical tests, one Internal and one External, are to be conducted.
* Each practical test will be of 25 marks.
* The marks in each practical test will be divided into 4 parts, program code, program execution , Viva-Voce and practical record book.
* The student has to pass both internal and external practical tests separately scoring a minimum of 10 marks in each test

COURSE OUCOMES

On successful completion of this course, we expect that a student

1 Should be able to appreciate the use of computers in engineering industry

2 Should have developed in him / her the basic understanding of computers, the concept of algorithms and algorithmic thinking.

3 Should have developed in him / her the ability to analyze a problem and develop an algorithm to solve it.

4 Should know the use of the C - programming language to implement various algorithms.