KAVAYITRI BAHINABAI CHAUDHARI NORTH MAHARASHTRA UNIVERSITY, JALGAON

'A' Grade
NAAC Re-accredited
(4th Cycle)

Semester-wise Code structure and Syllabus for

Faculty: Science and Technology

F. Y. B. Sc. (Mathematics)
(Honors/Research) Programme

As per NEP2020 for Affiliated Colleges

w.e.f. June 2024

Abbreviations:

- **T:** Theory Course
- **P:** Practical course
- **DSC:** Discipline Specific Core Course
- **DSE:** Discipline Specific ElectiveCourse
- **MIN:** Minor subject
- **VSEC:** Vocational skill and Skillenhancement courses
- **VSC:** Vocational Skill Courses
- **SEC:** Skill Enhancement Courses
- **GE/OE:** Generic/open elective
- **CI:** Constitution of India
- **IKS:** Indian Knowledge System
- **CEP:** Community engagement andservice
- **OJT**: On Job Training: Internship/Apprenticeship
- **RP:** Research Project
- **RM:** Research methodology
- **ES:** Environment studies
- **ENG:** English
- **MIL:** Modern Indian language

- **Co-curricular Course (CC)**
  - **a) CC-1: CC-120: Sports and Yoga**
  - **b) CC-2: CC-130: Cyber Security**
  - **c) CC-3: CC-220: Human Rights andEnvironment Law**
  - **d) CC-4: CC-229: CommunicationSkills and Personality Development**
- **Value Education Courses (VEC)**
  - **a) VEC1: ES-118: EnvironmentalScience**
  - **b) VEC2: CI-129: Constitution ofIndia**
- **Indian Knowledge System (IKS):**
  - **a) IK: 119: Ayurvedic Medicine in Ancient India**
- **Ability Enhancement Courses (AEC)**
  - **a) AEC-1: EG: 101 – English -1**
  - **b) AEC-2: EG: 102 – English -2**
  - **c) AEC-3: MR: 201 – Marathi -1**
  - **d) AEC-3: HN: 201 – Hindi -1**
  - **e) AEC-3: MR: 202 – Marathi -2**
  - **f) AEC-3: HN: 202 – Hindi -2**

Cognitive learning is a change in knowledge attributable to experience. This definition has three components: (1) learning involves a change, (2) the change is in the learner's knowledge, and (3) the cause of the change is the learner's experience.

Six levels of cognitive learning according to the revised version of Bloom's Taxonomy

Cognitive level	**1**	**2**	**3**	**4**	**5**	**6**
Cognitive task	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating

Semester-wise Code structure for B. Sc (Honors/Research) Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2024.											
B. Sc (Honors/Research) – First Year, SEMESTER – I, Level – 4.5											
Course	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Teaching Hours/ Week**			**Marks (Total 100)**			
					T	**P**	**Total**	**Internal (CA)**		**External (UA)**	
								T	**P**	**T**	**P**
DSC-1	**DSC**	**MT-111**	Theory of Equations	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-2	**DSC**	**MT-112**	Calculus of One Variable	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-3	**DSC**	**MT-113**	Theory of Matrices	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
MIN-1	**MIN**	**MT-114**	Set Theory and Logic	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
MIN-2	**MIN**	**MT-115**	Matrix Algebra	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
OE-1	**OE**	**MT-116**	Mathematics for Competitive Examinations	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
SEC-1	**SEC**	**MT-117**	Introduction to Scilab	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
VEC-1	**VEC**	**ES-118**	**Environmental Science**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
IKS	**IKS**	**IK-119**	**Ayurvedic Medicine in Ancient India**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
CC-1	**CC**	**CC-120**	**Sports and Yoga**	**2**	**2**	**--**	**2**	**50**	**--**	**--**	**--**
AEC-1	**AEC**	**EG-101**	**English -1**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
B. Sc (Honors/Research) – First Year, SEMESTER – II, Level – 4.5											
DSC-4	**DSC**	**MT-121**	Coordinate Geometry	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-5	**DSC**	**MT-122**	Mathematics of Vedic Tradition	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-6	**DSC**	**MT-123**	Ordinary Differential Equations	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
MIN-3	**MIN**	**MT-124**	Calculus	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
MIN-4	**MIN**	**MT-125**	Graph Theory	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
OE-2	**OE**	**MT-126**	Quantitative Aptitude and Logical Reasoning	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
SEC-2	**SEC**	**MT-127**	Introduction to SageMath	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
SEC-3	**SEC**	**MT-128**	Numerical Methods	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
VEC-2	**VEC**	**CI-129**	**Constitution of India**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
CC-2	**CC**	**CC-130**	**Cyber Security**	**2**	**2**	**--**	**2**	**50**	**--**	**--**	**--**
AEC-2	**AEC**	**EG-102**	**English -2**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
Cumulative Credits For First Year – 44											

***** Students need to complete one month on job training **(OJT)** or internship in any industry related to major subject.

Semester-wise Code structure for B. Sc (Honors/Research) Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2024.											
B. Sc (Honors/Research) – Second Year, SEMESTER – III, Level – 5.0											
Course	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Teaching Hours/ Week**			**Marks (Total 100)**			
					T	**P**	**Total**	**Internal (CA)**		**External (UA)**	
								T	**P**	**T**	**P**
DSC-7	**DSC**	**MT-211**	Calculus of Several Variables	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-8	**DSC**	**MT-212**	Partial Differential Equations	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-9	**DSC**	**MT-213**	Practical Course on Calculus of Several Variables using C++	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
DSC-10	**DSC**	**MT-214**	Practical Course on Partial Differential Equations using C++	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
MIN-5	**MIN**	**MT-215**	Analysis	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
MIN-6	**MIN**	**MT-216**	Practical Course on Analysis using C++	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
OE-3	**OE**	**MT-217**	Business Mathematics	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
VSC-1	**VSC**	**MT-218**	Combinatorics	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
VSC-2	**VSC**	**MT-219**	Practical course on Combinatorics using Python	**2**	**--**	**4**	**4**	**--**	**20**	**--**	**30**
CC-3	**CC**	**CC-220**	**Human Rights and Environment Law**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
AEC-3	**AEC**	**MR-201**	**Marathi -1**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
		HN-201	**Hindi -1**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
B. Sc (Honors/Research) – Second Year, SEMESTER – IV, Level – 5.0											
DSC-11	**DSC**	**MT-221**	Complex Variables	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-12	**DSC**	**MT-222**	Algebra	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-13	**DSC**	**MT-223**	Practical Course Complex Variables using Python	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
DSC-14	**DSC**	**MT-224**	Practical Course Algebra using Python	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
MIN-7	**MIN**	**MT-225**	Geometry	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
MIN-8	**MIN**	**MT-226**	Practical on Geometry using Scilab	**2**	**---**	**4**	**4**	**---**	**20**	**---**	**30**
OE-4	**OE**	**MT-227**	Mathematics for social sciences	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
CEP	**CEP**	**CEP-228**	Community engagement and service	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
CC-4	**CC**	**CC-229**	**Communication Skills and Personality Development**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
AEC-4	**AEC**	**MR-202**	**Marathi -2**	**2**	**2**	**--**	**2**	**20**	**--**	**30**	**--**
		HN-202	**Hindi -2**								
Cumulative Credits For First Year – 44											

Semester-wise Code structure for B. Sc (Honors/Research) Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2024.

B. Sc (Honors/Research) – Third Year, SEMESTER – V, Level – 5.5

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks (Total 100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
DSC-15	DSC	MT-311	Real Analysis	2	2	---	2	20	---	30	---
DSC-16	DSC	MT-312	Modern Algebra	2	2	---	2	20	---	30	---
DSC-17	DSC	MT-313	Number Theory	2	2	---	2	20	---	30	---
DSC-18	DSC	MT-314	Practical Course on Real Analysis and Modern Algebra using Scilab	2	---	4	4	---	20	---	30
DSC-19	DSC	MT-315	Practical Course in Number Theory using Scilab	2	---	4	4	---	20	---	30
DSE-1	DSE	MT-316 (A)	Laplace Transforms	2	2	---	2	20	---	30	---
		MT-316 (B)	Dynamics	2	2	---	2	20	---	30	---
DSE-2	DSE	MT-317	Practical Course on Laplace Transform	2	---	4	4	---	20	---	30
MIN-9	MIN	MT-318	Practical Course on Geogebra	2	2	---	2	20	---	30	---
VSC-3	VSC	MT-319	Differential Equations	2	2	---	2	20	---	30	---
FP	FP	MT-320	**Field Project**	4	--	8	8	--	40	--	60

B. Sc (Honors/Research) – Third Year, SEMESTER – VI, Level – 5.5

DSC-20	DSC	MT-321	Metric Spaces	2	2	---	2	20	---	30	---
DSC-21	DSC	MT-322	Linear Algebra	2	2	---	2	20	---	30	---
DSC-22	DSC	MT-323	Integral Calculus	2	2	---	2	20	---	30	---
DSC-23	DSC	MT-324	Practical Course in Metric Spaces and Integral Calculus using SageMath	2	---	4	4	---	20	---	30
DSC-24	DSC	MT-325	Practical Course in Linear Algebra using SageMath	2	---	4	4	---	20	---	30
DSE-3	DSE	MT-326 (A)	Optimization Techniques	2	2	---	2	20	---	30	---
		MT-326 (B)	Fourier Transforms	2	2	---	2	20	---	30	---
DSE-4	DSE	MT-327 (A)	Practical Course on Optimization Techniques	2	---	4	4	---	20	---	30
		MT-327 (B)	Practical Course on Fourier Transforms using Scilab	2	---	4	4	---	20	---	30
MIN-10	MIN	MT-328	Computational Algebra	2	2	---	2	20	---	30	---
VSC-4	VSC	MT-329	Integral Transforms	2	2	--	2	20	--	30	--
*OJT/ Int	OJT/Int	MT-330	**On Job Training/Internship**	4	--	8	8	--	40	--	60

* Students need to complete one month on job training **(OJT)** or internship in any industry related to major subject.

Semester-wise Code structure for B. Sc (Honors/Research) Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2024.											
B. Sc (Honors/Research) – 4th Year (Honors), SEMESTER – VII, Level – 6.0											
Course	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Teaching Hours/ Week**			**Marks (Total 100)**			
					T	**P**	**Total**	**Internal (CA)**		**External (UA)**	
								T	**P**	**T**	**P**
DSC-25	**DSC**	**MT-411**	Advanced real analysis	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSC-26	**DSC**	**MT-412**	Topology	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-27	**DSC**	**MT-413**	Abstract Algebra	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSC-28	**DSC**	**MT-414**	Programming in C++	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSE-5	**DSE**	**MT-415 (A)**	Partial Differential Equations	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
		MT-415 (B)	Topics in Graph Theory	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
RM	**RM**	**MT-416**	**Research Methodology**	**4**	**4**	**--**	**4**	**40**	**--**	**60**	**--**
B. Sc (Honors/Research) – 4th Year (Honors), SEMESTER – VIII, Level – 6.0											
DSC-30	**DSC**	**MT-421**	Complex Analysis	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSC-31	**DSC**	**MT-422**	Theory of Modules	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-32	**DSC**	**MT-423**	Field Theory	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSC-33	**DSC**	**MT-424**	Analytic Number Theory	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSE-6	**DSE**	**MT-426(A)**	Integral Equations	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
		MT-426(B)	Classical Mechanics	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
***OJT/ Int**	**OJT/Int**	**MT-427**	**On Job Training/Internship**	**4**	**--**	**8**	**8**	**--**	**40**	**--**	**60**

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Semester-wise Code structure for B. Sc (Honors/Research) Programme as per NEP2020, for Affiliated Colleges w.e.f – June 2024.											
B. Sc (Honors/Research) – 4th Year (Research), SEMESTER – VII, Level – 6.0											
Course	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Teaching Hours/ Week**			**Marks (Total 100)**			
					T	**P**	**Total**	**Internal (CA)**		**External (UA)**	
								T	**P**	**T**	**P**
DSC-25	**DSC**	**MT-411**	Abstract Algebra	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSC-26	**DSC**	**MT-412**	Latex	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-28	**DSC**	**MT-414**	Topology	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSE-5	**DSE**	**MT-416 (A)**	Theory of Special Functions	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
		MT-416 (B)	Universal Algebra	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
RM	**RM**	**MT-417**	**Research Methodology**	**4**	**4**	**--**	**4**	**40**	**--**	**60**	**--**
RP	**RP**	**MT-417**	**Research Project**	**4**	**--**	**8**	**8**	**--**	**40**	**--**	**60**
B. Sc (Honors/Research) – 4th Year (Research), SEMESTER – VIII, Level – 6.0											
DSC-30	**DSC**	**MT-421**	Complex Analysis	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSC-31	**DSC**	**MT-422**	Analytic Number Theory	**2**	**2**	**---**	**2**	**20**	**---**	**30**	**---**
DSC-33	**DSC**	**MT-424**	Theory of Modules	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
DSE-6	**DSE**	**MT-426(A)**	Integral Equations	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
		MT-426(B)	Classical Mechanics	**4**	**4**	**---**	**4**	**40**	**---**	**60**	**---**
RP	**RP**	**MT-427**	**On Job Training/Internship**	**8**	**--**	**16**	**16**	**--**	**80**	**--**	**120**
* Students need to complete one month on job training **(OJT)** or internship in any industry related to major subject.											

Course Code: MT-111
Course Title: Theory of Equations

Course Code: MT-111	**Course Category: Core Course (DSC-1)**
Course Title: Theory of Equations	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To study Principle of Mathematical Induction and Divisibility of numbers.
- To study roots of polynomial equations and Fundamental theorem of algebra.
- To know relations between roots and coefficients of polynomials of degree ≤ 4.
- To know roots of cubic equations by using Cardon's method, biquadratic equations by Descarte's method and roots of polynomial equations by Newton's method

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Use of Principle of Mathematical Induction and understand Divisibility of numbers with their properties	3
• Find out roots of any equation of degree ≤ 5.	5
• Know the relation between roots and coefficient of quadratic, cubic and biquadratic equations and their use for finding the roots of equation.	2
• Use of Cardon's method, Descarte's method for solving equations.	3

Course Content:

Unit-1. Divisibility of Integers **Hours-7, Marks-7**

1.1 Natural numbers
1.2 Well ordering principle (statement only)
1.3 Principle of Mathematical Induction
1.4 Divisibility of integers and theorems
1.5 Division algorithm
1.6 GCD and LCM
1.7 Euclidean algorithm
1.8 Unique factorization theorem

Unit-2. Polynomials **Hours-8, Marks-8**

2.1 Revision of Polynomials
2.2 Horner's method of synthetic division
2.3 Existence and uniqueness of GCD of two polynomials
2.4 Polynomial equations
2.5 Factor theorem and generalized factor theorem for polynomials
2.6 Fundamental theorem of algebra (Statement only)
2.7 Methods to find common roots of polynomial equation
2.8 Descarte's rule of signs
2.9 Newton's method of divisors for the integral roots

Unit-3. Theory of Equations-I **Hours-7, Marks-7**

3.1 Relation between roots and coefficient of general polynomial equation in one variable
3.2 Relation between roots and coefficient of quadratic equations
3.3 Cubic and biquadratic equations
3.4 Symmetric functions of roots

Unit-4. Theory of Equations –II **Hours-8, Marks-8**

4.1 Transformation of equations
4.2 Cardon's method of solving cubic equations

Reference Books:

1. Burton, D. M. (1989). *Elementary Number Theory*. W. C. Brown publishers, Dubuquolowa.
2. Hall, H. S., and Knight, S. R.(1994). *Higher Algebra*. H. M. Publications.
3. Datta, K. B. (2000). *Matrix and Linear Algebra.* Prentice Hall of India Pvt. Ltd., New Delhi.
4. Sharma, D. R. (1985). *Theory of Equations*. Sharma Publications, Jalandhar.

Course Code: MT-112
Course Title: Calculus of One Variable

Course Code: MT-112	**Course Category: Core Course (DSC-2)**
Course Title: Calculus of One Variable	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are

- To understand and apply the fundamental principles of calculus, including limits, continuity, differentiation, and integration.
- To develop the ability to evaluate limits using the epsilon-delta definition, understand the basic properties of limits, and solve problems involving indeterminate forms using L-Hospital's rule.
- To explore the properties of continuous functions on closed and bounded intervals, including boundedness, attainment of bounds, and the application of the Intermediate Value Theorem.
- To apply theorems such as Rolle's theorem, Lagrange's Mean Value Theorem, and Cauchy's Mean Value Theorem to analyze functions, solve problems and make geometric interpretations.
- To find higher-order derivatives of standard functions and apply Leibniz's Theorem for products of functions to solve complex differentiation problems.
- To utilize Taylor's theorem with Lagrange's form of remainder, Maclaurin's theorem and reduction formulae to approximate functions, solve problems involving power series and simplify definite integrals with trigonometric functions.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Develop a deep and fundamental understanding of the core principles of calculus, including limits, continuity, derivatives, and integrals.	6
• Understand basic concepts on limits and continuity. Also use of differentiations in various theorems.	2
• Possess advanced problem-solving skills, enabling them to tackle a wide range of mathematical problems, including those related to continuity, differentiability, and successive differentiation.	5
• Know the Mean value theorems, Taylor's, Maclaurin's theorem and its applications.	2
• Interpret the derivative as the slope of a tangent line to a graph, the slope of a graph at a point, and the rate of change of a dependent variable with respect to an independent variable.	4
• Use the first and second derivatives to analyze and sketch the graph of a function, intervals on which the graph is increasing, decreasing.	3

Course Content:

Unit-1. Limit and Continuity **Hours-7, Marks-7**

1.1 Epsilon-delta definition of limit of a function
1.2 Basic properties of limit, Indeterminate forms
1.3 L-Hospital's rule, Examples of limit
1.4 Continuous function and examples.
1.5 Properties of continuous function on closed and bounded interval
i. Boundedness (Statement only)
ii. Attains its bounds
iii. Indeterminate mean value theorem
iv. Uniform continuity

Unit-2. Mean Value Theorems **Hours-8, Marks-8**

2.1 Differentiability
2.2 Definition of derivative, Theorem on continuity and examples
2.3 Roll's theorem and examples
2.4 Langrage's mean value theorem and examples
2.5 Cauchy's mean value theorem and examples
2.6 Basic geometrical interpretation and alternating forms (statement only)
2.7 Increasing and decreasing function, examples

Unit-3. Successive Differentiation **Hours-7, Marks-7**

3.1 Definition of successive differentiation
3.2 Notation for higher-order derivatives
3.3 n^{th} derivatives of standard functions and examples
3.4 Leibnitz's Theorem and examples

Unit-4. Taylor's Theorem and Reduction Formulae **Hours-8, Marks-8**

4.1 Taylor's theorem with Lagrange's form of remainder and related examples
4.2 Maclaurin's theorem with Lagrange's form of remainder and related examples
4.3 Reduction formulae (without proof) and examples

$$\int_0^{\frac{\pi}{2}} \sin^n x\,dx, \quad \int_0^{\frac{\pi}{2}} \cos^n x\,dx, \int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\ dx \text{and} \int_0^{\frac{\pi}{2}} \frac{\sin(nx)}{\sin x}\,dx$$

Reference Books:

1. Wrede,Robert, and Spiegel, Murray R. (2002). *Theory and Problems of Advanced Calculus*. Second Edition. McGraw-Hill Company. New York.
2. Prasad,Gorakh. (1959).*Text Book on Differential calculus*. Pothishala Pvt. Ltd. Allhabad.
3. Prasad,Gorakh. (2015). *Integral calculus*. Pothishala Pvt. Ltd. Allhabad.
4. Maron,I. A. (2026).*Problems in Calculus of One Variable*. CBS Publishers and Distributors.

Course Code: MT-113
Course Title: Theory of Matrices

Course Code: MT-113	**Course Category: Core Course (DSC-3)**
Course Title: Theory of Matrices	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: The main objectives are: • To understand the concepts and applications of matrices.	

• To improve problem solving and logical thinking abilities of the students. • To study the concepts of theory of matrices in linear algebra. • To use theory of matrices in solving linear equations.	
Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Understand operations on matrices.	2
• Understand the concept of rank of a matrix and inverse of a matrix.	2
• Understand the concept of eigenvalues and eigenvectors.	2
• Understand the concept of orthogonal matrices, quadratic forms, diagonal forms and canonical forms.	2

Course Content:

Unit-1. Adjoint and Inverse of a Matrix **Hours-8, Marks-8**

1.1 Definition and types of a matrices
1.2 Elementary operations on matrices
1.3 Minors and Co-factors of a matrix
1.4 Adjoint of a matrix & Inverse of a matrix
1.5 Existence & uniqueness theorem of inverse of a matrix
1.6 Properties of inverse of a matrix

Unit-2. Rank of Matrix **Hours-7, Marks-7**

2.1 Elementary matrices
2.2 Rank and normal form of a matrix
2.3 Reduction of a matrix to its normal form
2.4 Rank of product of two matrices

Unit-3. System of Linear Equations and Eigen Values **Hours-8, Marks-8**

3.1 Homogeneous and non-homogeneous system of linear equations
3.2 Consistency of system of linear equations
3.3 Application of matrices to solve the system of linear equations
3.4 Characteristic equation of a matrix
3.5 Eigen values and Eigen vectors of matrices
3.6 Cayley Hamilton theorem (statement only) and its use to find the inverse of a matrix

Unit-4. Orthogonal Matrices and Quadratic Forms **Hours-7, Marks-7**

4.1 Orthogonal matrices and properties of orthogonal matrices
4.2 Quadratic forms: matrix representations
4.3 Elementary congruent transformations
4.4 Diagonal form of a quadratic form
4.5 Canonical forms

Reference Books:

1. Datta, K. B. (2000). *Matrix and Linear Algebra*. Prentice Hall of India Pvt.. New Delhi..
2. Narayan, Shanti. (2010). *A Text Book of Matrices*. S. Chand Limited. New Delhi.
3. Bronson,Richord. (1989). *Schaum's Outline of Theory and Problem of MATRICES*. McGraw-Hill. New Delhi.
4. Vince, John A. (2010).*Mathematics for Computer Graphics*. Springer-Verlag London.

Course Code: MT-114
Course Title: Set Theory and Logic

Course Code: MT-114	**Course Category: Core Course (MIN-1)**
Course Title: Set Theory and Logic	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To acquire concepts of sets, operations on sets, Venn diagrams, countable and uncountable sets.
- To acquire concepts of relations, equivalence relations, functions and their types.
- To acquire concepts of statements, truth values and logical equivalences.
- To acquire concepts of universal and existential quantifiers.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Use of the language of set theory, designing issues in different subjects of mathematics. Also understand the issues associated with different types of finite and infinite sets via countable and uncountable sets.	3
• Learn how to identify, represent and recognize relations and functions from schematic descriptions, arrow diagrams and graphs.	1
• Use truth tables and logical operators to solve the mathematical problems.	3
• Provide the logical mathematical reasoning to formulate theorems and definitions.	6

Course Content:

Unit-1. Sets and Subsets **Hours-7, Marks-7**

1.1 Finite Set and Infinite set
1.2 Equality of two Sets,
1.3 Null Set, Subset, Proper subset and Symmetric difference of two sets
1.4 Universal set, Power set and Disjoint sets
1.5 Operation on sets: Union, Intersection and Compliment
1.6 Venn diagram
1.7 Equivalent sets
1.8 Countable and uncountable sets

Unit-2. Relations and Functions **Hours-8, Marks-8**

2.1 Product of sets
2.2 Relations, Types of relations, Reflexive, Symmetric, Transitive relations and Equivalence relations
2.3 Function, Types of functions, One-one, Onto, Even, Odd and Inverse function
2.4 Composite functions

Unit-3. Algebra of Propositions **Hours-7, Marks-7**

3.1 Statements, Conjunction, Disjunction.
3.2 Negation, Conditional and Bi-Conditional statements, Propositions.
3.3 Truth table, Tautology and Contradiction.
3.4 Logical equivalence and Logical equivalent statements

Unit-4. Quantifiers **Hours-8, Marks-8**

4.1 Propositional functions and Truth sets
4.2 Universal quantifier, Existential quantifier
4.3 Negation of proposition which contain quantifiers and Counter examples

Reference Books:

1. Lipschutz, Seymour. (1964). *Set Theory and Related Topics*. Schaum's Series. McGraw-Hill. New York.
2. Halmons, P. R. (1974). *Naïve Set Theory* (Revised ed.). Springer.
3. Kamke, E. (1950). *Theory of Sets*. Dover Publishers.

Course Code: MT-115
Course Title: Matrix Algebra

Course Code: MT-115	**Course Category: Core Course (MIN-2)**
Course Title: Matrix Algebra	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To understand the basic knowledge and applications of determinants and matrices in various fields.
- To teach mathematical approaches and models to grow mathematical skill
- To improve mathematical thinking of the students.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Understand concepts on determinants and matrix operations	2
• Understand application of determinants.	2
• Understand concepts adjoint and inverse of matrices.	2
• Understand concepts rank of the matrix.	2
• Understand use of matrix for solving the system of linear equations.	2

Course Content:

Unit-1. Determinants and adjoint of Matrices **Hours-8, Marks-8**

1.1 Definition and expansion of determinants
1.2 Properties of determinants
1.3 Application of determinants:
Cramer's Rule to solve linear equation in 2 and 3 variables
1.4 Definition of Matrix and Types of Matrices
1.5 Minor and cofactor of an element
1.6 Adjoint of matrix and examples

Unit-2. Inverse of square of matrices and elementary matrices **Hours-8, Marks-8**

2.1 Inverse of a matrix
2.2 Existence, uniqueness of inverse
2.3 Properties of inverse of a matrix
2.4 Elementary transformation
2.5 Equivalent matrices,
2.6 Elementary matrices,
2.7 Inverse of elementary matrices

Unit-3. Rank of Matrix and orthogonal matrices **Hours-7, Marks-7**

3.1 Definition of rank of matrix

3.2 Normal form of a matrix (definition only) and reduction to normal form

3.3 Orthogonal matrix and examples

Unit-4. System of Linear Equations **Hours-7, Marks-7**

4.1 Homogeneous and non-homogeneous system of linear equations

4.2 Consistency of system of linear equations

4.3 Application of matrices to solvable system of linear equations

Reference Books:

1. Datta K. B. (2000). *Matrix and Linear Algebra*. Prentice Hall of India Pvt.. New Delhi..
2. Narayan, Shanti. (2010). *A Text Book of Matrices*. S. Chand Limited. New Delhi.
3. Bronson,Richord. (1989). *Schaum's Outline of Theory and Problem of MATRICES*. McGraw-Hill. New Delhi.
4. Vince, John A. (2010). *Mathematics for Computer Graphics*. Springer-Verlag London.

Course Code: MT-116
Course Title: Mathematics for Competitive Examinations

Course Code: MT-116	**Course Category: Core Course (OE-1)**
Course Title: Mathematics for Competitive Examinations	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To develop skill to meet the competitive examinations for better job opportunity.
- To accommodate fundamental and mathematical aspects to instill confidence among students.
- To enrich their knowledge and develop their logical reasoning thinking ability.
- To acquire fundamental mathematics ratio, proportion, interests and percentage.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Understand and appreciate usage of mathematical concepts which are utmost important in all walks of life.	2
• Solve the problems easily by using short-cut methods with time management which will be helpful for them to clear the competitive examinations for better job opportunities.	5
• Analyze the problems logically and approach the problems in a different manner.	4

Course Content:

Unit 1. Numbers **Hours-7, Marks-7**

1.1 Number Systems

1.2 LCM and HCF

1.3 Decimal Fractions

1.4 Simplification

Unit 2. ArithmeticProblems-I **Hours-8, Marks-8**

1.5 Square Roots and Cube Roots
2.1 Average
2.2 Problems on Numbers
2.3 Problems on Ages

Unit 3. Arithmetic Problems-II **Hours-7, Marks-7**

3.1 Surds and Indices
3.2 Logarithm
3.3 Percentage
3.4 Profit and loss

Unit 4. Aptitude Problems **Hours-8, Marks-8**

4.1 Ratio and proportion
4.2 Partnership
4.3 Chain rule
4.4 Pipe and Cisterns

Reference Books:

1. Aggarwal, R. S. (2016). *Quantitative Aptitude (Fully solved)*. S. Chand.
2. Praveen, R.V. (2013). *QuantitativeAptitude and Reasoning*. 2nd Revised Edition. Prentice-Hall of India Pvt.Ltd.
3. Ranganath,G. K.,Sampangiram, C. S. andRajaram, Y. (2008). *A text Book of business Mathematics*. Himalaya Publishing House.
4. Guha, A. (2016).*Quantitative Aptitude for Competitive Examination*. Tata McGraw hill Publications.

Course Code: MT-117
Course Title: Introduction to Scilab

Course Code: MT-117	**Course Category: Core Course (SEC-1)**
Course Title: Introduction to Scilab	**Type: Practical**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To introduce the students to the Scilab software environment and its applications.
- To enable students to perform fundamental mathematical operations and manage variables in Scilab.
- To teach students basic programming concepts and how to implement them in Scilab.
- To equip students with the skills needed to load, process, and visualize data using Scilab.
- To introduce students to numerical methods and their practical application using Scilab.
- To expose students to advanced Scilab topics, laying the foundation for further exploration.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Demonstrate proficiency in using Scilab's interface, including launching the application, performing basic calculations, and managing variables.	6
• Solve a variety of mathematical problems using Scilab, including arithmetic calculations, equation solving, and matrix operations.	5

• Gain introductory programming skills, including the ability to create and use functions, implement loops and conditional statements, and organize code into scripts.	2
• Capable of loading, analyzing, and visualizing data using Scilab, including creating basic plots and customizing them to effectively represent data.	4
• Understand numerical methods particularly numerical integration and differentiation, and will apply these methods to solve practical problems using Scilab.	2
• Exposed advanced Scilab concepts such as symbolic mathematics, advanced matrix operations, and file input/output. While not experts, they will have a foundation for further exploration or more advanced coursework in these areas.	6

Course Content:

Unit-1. Getting Started with Scilab **Hours-30, Marks-15**

1.1 Introduction to Scilab
1.2 Basic Operations and Variables
1.3 Matrices and Matrix Operations
1.4 Logical Operations and Control Structures
1.5 Functions and Scripting
1.6 Basic Plotting
1.7 File Input and Output
1.8 Symbolic Mathematics

Practicals:

1. Launch Scilab, and calculate the sum of three numbers: 7, 15, and 22.
2. Declare two variables, a and b, with values 10 and 3, respectively. Calculate the result of $a * b - 2$.
3. Create a 2×2 matrix A with elements $\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}$ and another matrix B with elements $\begin{bmatrix}5 & 6\\7 & 8\end{bmatrix}$. Calculate the product $C = A * B$.
4. Write a Scilab script that checks if a given number (e.g., 9) is divisible by 3 and displays an appropriate message.
5. Create a Scilab function to calculate the area of a rectangle given its length and width. Use the function to find the area of a rectangle with length 5 units and width 8 units.
6. Plot the sine function ($sin(x)$) for values of x ranging from 0 to 2π. Customize the plot with labels, a title, and a grid.
7. Load a text file containing a list of numbers (e.g., numbers.txt) into Scilab, calculate the sum of the numbers, and save the result to another text file (e.g., result.txt).
8. Use Scilab's symbolic toolbox to solve the quadratic equation: $ax^2 + bx + c = 0$, where $a = 1, b = -4$, and $c = 3$.
9. Take a string as input from the user, reverse it, and display the reversed string using Scilab.
10. Generate a random dataset of 20 numbers between 1 and 100 in Scilab. Calculate the mean and standard deviation of the dataset.

Unit-2. Scilab Concepts **Hours-30, Marks-15**

2.1 Advanced Plotting and Graphics
2.2 Advanced Matrix Operations

2.3 Numerical Methods
2.4 Data Analysis and Statistics
2.5 File Input and Output
2.6 Symbolic Mathematics
2.7 Introduction to Simulations and Modeling

Practicals:

1. Create a scatter plot in Scilab with randomly generated data points. Customize the plot with labels and markers.
2. Find the determinant of a 3x3 matrix M with elements $\begin{bmatrix}1 & 2 & 3\\4 & 5 & 6\\7 & 8 & 9\end{bmatrix}$ using Scilab.
3. Use Scilab to approximate the value of π (pi) using the Monte Carlo method by randomly generating points inside a unit square and counting those that fall inside a unit circle.
4. Load a dataset of students' exam scores into Scilab. Calculate the median score and create a box plot to visualize the data.
5. Import a CSV file containing sales data into Scilab. Calculate the total sales revenue, and export the result to another CSV file with a summary.
6. Use Scilab's symbolic toolbox to find the indefinite integral of the function $f(x) = x^2 + 2x + 1$ with respect to x.
7. Create a simple Monte Carlo simulation in Scilab to estimate the probability of rolling a 6 with a fair six-sided die. Run the simulation for 1000 trials.
8. Generate noisy data points for a known mathematical function (e.g., $y = 2x^2 + 3x + 1$) and use Scilab to perform curve fitting to estimate the function's parameters.
9. Load a dataset of monthly temperature records for a year. Create a line chart to visualize the temperature variations over the months.
10. Use Scilab to perform numerical integration to estimate the area under the curve of a given mathematical function within a specified interval.

Recommended Books:

1. Rangarajan, Prabhu. (2020). *Scilab for Real Dummies*. Amazon.com Services LLC,Weblink: Scilab for Real Dummies on Amazon
2. Shyam, Tejas. (2020). *Scilab: A Practical Introduction and User Guide*.
   Weblink: Scilab: A Practical Introduction and User Guide on Amazon
3. Stephen L. Campbell and Jean-Philippe Chancelier. (2015). *Scilab: From Theory to Practice - I.* Fundamentals. Springer.
   Weblink: *Scilab: From Theory to Practice - I.* Fundamentals on Springer
4. Ahmad, Suhail. (2017). *Scilab for Engineers and Scientists*. Springer.
   Weblink: Scilab for Engineers and Scientists on Springer

Semester–II

Course Code: MT-121
Course Title: Coordinate Geometry

Course Code: MT-121	**Course Category: Core Course (DSC-4)**
Course Title: Coordinate Geometry	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To develop a strong foundation in two/three-dimensional geometry to understand shapes and concepts.
- To explore three-dimensional geometry, focusing on properties and interpretations of Sphere, Cone, and Cylinder.
- To acquire essential skills for solving geometric problems and applying these concepts in various mathematical contexts.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Gain a thorough understanding of two-dimensional geometry, including principles of shapes, angles, and properties of various geometric figures.	2
• Acquire comprehensive knowledge of three-dimensional geometry, focusing on the properties and applications of spheres, cones, and cylinders.	2
• Demonstrate the ability to interpret and analyze three-dimensional shapes in real-world scenarios.	6
• Apply acquired geometric knowledge to solve practical problems and make informed decisions in relevant fields.	3

Course Content:

Unit-1. Straight Line in 3D **Hours-8, Marks-8**

1.1 Representation of line in 3D
1.2 Equation of line through a given point drawn in a given direction
1.3 Equation of a line through two points
1.4 Transformation from the unsymmetrical to the symmetrical form
1.5 Angle between two lines
1.6 General equation of first degree
1.7 Transformation to the normal form and Angle between a line and a plane
1.8 Condition for a line to lie in a plane
1.9 Coplanar line and point of intersection of two lines
1.10 Angle between a line and a plane

Unit-2. Sphere **Hours-8, Marks-8**

2.1 Equation of Sphere
2.2 General equation of sphere
2.3 Sphere through four given points
2.4 Plane section of a sphere
2.5 Intersection of two sphere and touching spheres

2.6 Intersection of sphere and line
2.7 Sphere with a given diameter
2.8 Tangent line and tangent plane
2.9 Condition of tangency and Section of sphere by a plane
2.10 Equation of circle
2.11 Angle of intersection of two sphere

Unit-3. Cone **Hours-7, Marks-7**

3.1 Definition
3.2 Equation of a cone with a conic as guiding curve
3.3 Enveloping cone of a sphere
3.4 Condition that the general equation of the second degree should represent a cone
3.5 Cone and Plane through its vertex
3.6 Intersection of Line with a cone
3.7 Right Circular cones

Unit-4. Cylinder **Hours-7, Marks-7**

4.1 Definition
4.2 Equation of a cylinder
4.3 Enveloping Cylinder
4.4 Right circular cylinder

Reference Books:

1. Loney, S. L. (2016). *The Elements of Co-ordinate Geometry*. MacMillan and company. London.
2. Prasad, Gorakh, and Gupta, H. C. (2000).*Text Book on Co-ordinate Geometry*. Pothishala Pvt. Ltd. Allhabad.
3. Narayan, Shanti. (2007). *Analytical Solid Geometry*. S. Chand and Co..
4. Sharma, D. R. *Solid Geometry*. Sharma Publications, Jalandhar, 30th Edition.
5. Narayan, Shanti, and Mittal, P.K., *Analytical Solid Geometry*, S. Chand and Co.

Course Code: MT-122
Course Title: Mathematics of Vedic Tradition

Course Code: MT-122	**Course Category: Core Course (DSC-5) (IKS)**
Course Title: Mathematics of Vedic tradition	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- to introduce various Vedic methods of solving problems
- to make aware about historical background of mathematical formula and methods
- ancient derivations of calculus, differentiations, number theoretic problems reported in various granthas..

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Develop the understanding of objectives and features of Vedic mathematics.	6
• Recognize the meaning of mathematical sutras in Sanskrit.	1
• Understand the concept of Arithmetical Computations using Vedic point of view.	2
• Develop Analytical thinking through Vedic mathematics.	6

• Enable further research in Indian Mathematics.	6
• Promote Vedic culture.	1

Course Content:

Unit-1: Vedic Arithmetic's: **Hours-7, Marks-7**

1.1 Actual Applications of the Vedic Sutras
1.2 Arithmetical Computations
1.3 Multiplication
1.4 Practical Application (compound multiplication),
1.5 Practice and Proportion

Unit-2: Division and Factorization: **Hours-8, Marks-8**

2.1 Division by the Nikhilam method
2.2 Division by the Parevartpa method
2.3 Argumental Division and Factorization (of simple quadratics)
2.4 Factorization (of harder quadratics)
2.5 Factorization of Cubics
2.6 Highest Common Factor

Unit-3: Simple equations: **Hours-7, Marks-7**

3.1 Simple Equations (First Principles)
3.2 Simple Equations (by Sunyam etc.)
3.3 Merger Type of Easy Simple Equations
3.4 Extension method
3.5 Complex Mergers
3.6 Simultaneous Simple Equations
3.7 Miscellaneous (Simple) Equations

Unit-4: Equations and Calculus: **Hours-8, Marks-8**

4.1 Quadratic Equations
4.2 Cubic Equations
4.3 Bi-quadratic Equations
4.4 Multiple Simultaneous Equations
4.5 Simultaneous Quadratic Equations
4.6 Factorization & Differential Calculus
4.7 Partial Fractions
4.8 Integration by Partial Fractions

Reference Book:

1. Jagadguru Swami Sri Bharati Krisna Tirthaji Maharaja. (1981). *Vedic Mathematics.* Edited by Dr. V. S. Agrawala, Motilal Banaridas, Delhi.

Course Code: MT-123
Course Title: Ordinary Differential Equations

Course Code: MT-123	**Course Category: Core Course (DSC-6)**
Course Title: Ordinary Differential Equations	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: The main objectives are:	

• To understand the different methods of solving differential equations and their applications to solve problems arrive in engineering and technology. • To evaluate first order differential equations including homogeneous, exact and linear differential equations. • To solve second order and higher orders linear differential equations. • To know the concept of homogeneous linear differential equations.	
Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Understand basic concepts in differential equations.	2
• Understand method of solving differential equations. • Understand use of differential equations in various fields.	2 2
• Understand the method of solving the homogeneous linear differential equation.	2

Course Content:

Unit-1. Differential Equations of First Order and First Degree **Hours-8, Marks-8**

1.1 Partial derivatives of first order and second orders and examples
1.2 Exact differential equations
1.3 Condition for exactness
1.4 Integrating factor
1.5 Rules for finding integrating factors

Unit-2. Linear differential equations **Hours-7, Marks-7**

2.1 Linear differential equations
2.2 Bernoulli's differential equation
2.3 Equation reducible to linear form
2.4 Equations reducible to Bernoulli's differential equation

Unit-3. Linear Differential Equations of Second and Higher Order **Hours-8, Marks-8**

3.1 Linear differential equations with constant coefficients
3.2 Complementary functions
3.3 Particular integrals of $f(D)y = X$ where $X = e^{ax}$, $\sin(ax)$, $\cos(ax)$, x^n, $e^{ax}V$, xV with usual notations

Unit-4. Homogeneous Linear Differential Equations **Hours-7, Marks-7**

4.1 Homogeneous linear differential equations (Cauchy's differential equations)
4.2 Examples of homogeneous linear differential equations
4.3 Equations reducible to homogeneous linear differential equations (Legendre's equations)
4.4 Examples of equations reducible to homogeneous linear differential equations

References Books:

- Murray, D. A. **(**1967**).** *Introductory Course in Differential Equations***.** Orient Congman (India).
- Simmons, G. F. **(**1972**).** *Differential Equations*, Tata McGraw Hill.

Course Code: MT-124
Course Title: Calculus

Course Code: MT-124	**Course Category: Core Course (MIN-3)**
Course Title: Calculus	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are

- To understand and apply the fundamental principles of calculus, including limits, continuity, differentiation, and integration.
- To develop the ability to evaluate limits using the epsilon-delta definition, understand the basic properties of limits, and solve problems involving indeterminate forms using L-Hospital's rule.
- To apply theorems such as Rolle's theorem, Lagrange's Mean Value Theorem, and Cauchy's Mean Value Theorem to analyze functions, solve problems.
- To find higher-order derivatives of standard functions and apply Leibniz's Theorem for products of functions to solve complex differentiation problems.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Develop a deep and fundamental understanding of the core principles of calculus, including limits, continuity, derivatives, and integrals.	6
• Understand basic concepts on limits and continuity. Also use of differentiations in various theorems.	2
• Possess advanced problem-solving skills, enabling them to tackle a wide range of mathematical problems, including those related to continuity, differentiability, and successive differentiation.	5

Course Content:

Unit-1. Limit and Continuity **Hours-7, Marks-7**

1.1 Epsilon-delta definition of limit of a function
1.2 Basic properties of limit and examples
1.3 Indeterminate forms, L-Hospital's rule and examples
1.4 Continuous function and examples
1.5 Uniform continuity and examples.

Unit-2. Derivatives **Hours-8, Marks-8**

2.1 Definition of derivative and its properties (without proof)
2.2 Definition of Successive Differentiation
2.3 n^{th} derivatives of standard functions and examples
2.4 Leibnitz's Theorem and examples

Unit-3. Integration and Reduction Formulae **Hours-8, Marks-8**

3.1 Integration and its properties
3.2 Integration by parts
3.3 Reduction formulae (without proof) and examples

$$\int_0^{\frac{\pi}{2}} \sin^n x\, dx, \quad \int_0^{\frac{\pi}{2}} \cos^n x\, dx, \int_0^{\frac{\pi}{2}} \sin^m x \cos^n x\ dx \text{and} \int_0^{\frac{\pi}{2}} \frac{\sin(nx)}{\sin x} dx$$

Unit-4. Mean Value Theorems **Hours-7, Marks-7**

4.1 Roll's theorem (without proof) and examples
4.2 Langrage's Mean value theorem (without proof) and examples
4.3 Cauchy's mean value theorem (without proof) and examples

Reference Books:

1. Wrede, Robert, and Spiegel, Murray R. (2002). *Theory and Problems of Advanced Calculus*. Second Edition. McGraw-Hill Company. New York.
2. Prasad, Gorakh. (1959). *Text Book on* Differential calculus. Pothishala Pvt. Ltd. Allhabad.
3. Prasad, Gorakh. *Integral calculus*. Pothishala Pvt. Ltd. Allhabad.

4. Maron, I. A. *Problems in Calculus of One Variable*. CBS Publishers and Distributors.

Course Code: MT-125
Course Title: Graph Theory

Course Code: MT-125	**Course Category: Core Course (MIN-4)**
Course Title: Graph Theory	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are

- To understand the concept of vertex connectivity and edge connectivity in graphs.
- To develop the under-standing of Geometric duals in Planar Graphs.
- To understand Konigsberg's Seven Bridge Problem.
- To understand the concept of Euler graph and Hamiltonian graph.
- To have an idea of matching in graphs and study some applications of matching in day to day life problems.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Define the basic concepts of graphs, identifying edges and vertices, finds the degree of a vertex and express and prove handshaking lemma.	1
• Understand the properties of connected graphs and trees.	2
• Understand Eulerian and Hamitonian graphs and basic results related with Eulerian and Hamiltonian graphs	2
• Understand the concept of plane graph and able to proves Euler's formula.	2

Course Content:

Unit-1. Graphs **Hours-8, Marks-8**

1.1 Graph, Simple graph, Multigraph
1.2 Hand shaking lemma
1.3 Types of Graphs
1.4 Operations on graphs
1.5 Subgraphs

Unit-2. Connected Graphs **Hours-8, Marks-8**

2.1 Walk, path, cycles (circuits)
2.2 Connected and disconnected Graphs
2.3 Bridges and Cut vertices
2.4 Edge connectivity and vertex connectivity
2.5 Eulerian graph and Konigsberg Seven Bridge Problem
2.6 Hamiltonian Graph

Unit-3. Planer Graphs **Hours-7, Marks-7**

3.1 Planer Graph
3.2 Euler's Formula for planer graphs (without proof) and examples
3.3 Kuratowski's two graph
3.4 Geometrical dual

Unit-4. Trees **Hours-7, Marks-7**

4.1 Definition of a tree and its properties

4.2 Distance and Centre in a tree
4.3 Spanning trees and Minimal Spanning trees

Reference books:

1. Deo, Narsingh.(1979). *Graph Theory with Applications to Engineering and Computer science*. Prentice Hall of India Pvt. Ltd.
2. Lipschitz, Seymour, and Lipson, Marc Lars. (2007). *Theory and Problems of Discrete Mathematics*. Schaum's outline series. McGraw-Hill Ltd. New York.

Course Code: MT-126
Course Title: Quantitative Aptitude and Logical Reasoning

Course Code: MT-126	**Course Category: Core Course (OE-2)**
Course Title: Quantitative Aptitude and Logical Reasoning	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To enhance the analytical skill and problem-solving skill of the students.
- To improve verbal ability skill of the students.
- To improve the critical thinking skills of the students.
- To make them prepare for various public and private sector exams & placement drives.

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Understand the basic concepts of quantitative ability.	2
• Understand the basic concepts of logical reasoning skills.	2
• Acquire satisfactory competency in use of reasoning.	3
• Solve campus placement aptitude papers.	3
• Prepare themselves for various competitive examinations.	6

Course Content:

Unit-1. Time, work and distances **Hours-7, Marks-7**

1.1 Time and work
1.2 Time and Distance
1.3 Boats and Stream

Unit-2. Arithmetic Problems **Hours-8, Marks-8**

2.1 Allegation and Mixtures
2.2 Simple interest
2.3 Compound interest

Unit-3. Aptitude Problems **Hours-7, Marks-7**

3.1 Calendar
3.2 Clocks
3.3 Height and Distances

Unit-4. Logical Reasoning **Hours-8, Marks-8**

4.1 Odd man out
4.2 Problems on Series
4.3 Problems on train

Reference Books:

1. Aggarwal, R. S. (2022). *Quantitative Aptitude*. S. Chand Publications.
2. Aggarwal, R. S. (2022). *A Modern Approach to Logical Reasoning*. S. Chand Publications.
3. Jaikishan, and Premkishan. (2022). *How to Crack Test of Reasoning in all competitive exams*. Arihant Publications.
4. Oswaal Editorial Book. (2023). *Quantitative Aptitude*. Oswaal Books & Learning Pvt. Ltd.

Course Code: MT-127
Course Title: Introduction to SageMath

Course Code: MT-127	**Course Category: Core Course (SEC-2)**
Course Title: Introduction to SageMath	**Type: Practical**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives: The main objectives are:

- To Understand the fundamentals of SageMath and its utilization.
- To know Familiarization of the syntax of numerical computing language-SageMath.
- To study Application of SageMath for implementation/simulation andvisualization of basic mathematical computations

Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• To Implement and determine simple mathematical computations in SageMath.	3
• To Interpret and visualize simple mathematical functions using SageMath tools.	2
• To Analyze the mathematical problem with simulation environment in SageMath.	4
• Understand the need for simulation/implementation for the verification of mathematical functions.	2

Course Content:

Unit-1. Introduction to SageMath **Hours-14, Marks-7**

1.1 Introduction to SageMath
1.2 What is SageMath, Downloading & Installing SageMath,
1.3 A quick taste of SageMath
1.4 The SageMath environment – manipulating the command line, working directory, comments
1.5 Installation of Python
1.6 Getting Started with Python
1.7 Python as an advanced calculator
1.8 Lists in Python
1.9 Tuple, Sets and Dictionaries in Python
1.10 Functions and Branching
1.11 For loop in Python
1.12 While loop in Python

Unit-2. Elementary Mathematics Through SageMath **Hours-16, Marks-8**

2.1 Applications of derivatives

2.2 Matrices – introduction, arithmetic operators for matrices
2.3 Solving system of linear Equations in SageMath
2.4 Basic matrix processing, Eigenvalues and Eigenvectors with SageMath
2.5 Polynomials–introduction, creating polynomials, basic polynomial commands
2.6 Finding roots of polynomial, polynomial arithmetic
2.7 Integration with SageMath
2.8 Improper Integral using SageMath
2.9 Application of integration using SageMath
2.10 Limit and Continuity of real valued functions
2.11 Partial Derivative with SageMath
2.12 Local Maximum and Minimum.

Unit-3. Some Applicationsof SageMaths **Hours-14, Marks-7**

3.1 Google Page Rank Algorithm using SageMath
3.2 Solving 1st and 2nd order ODE with SageMath
3.3 Euler's Method to solve 1st order ODE with SageMath
3.4 Introduction to Linear Programming Problems (LPP)
3.5 Solving Linear Programming Problmes using Graphical Methods
3.6 Basics Definitions and Results in LPP

Unit-4. Graphics and Applications in SciLab **Hours-16, Marks-8**

4.1 2d Plotting with SageMath
4.2 3d Plotting with SageMath, Calculus of one variable with SageMath

Reference Books:

1. Zimmermann, Paul. *Mathematical Computation with Sage.* http://www.SageMath.org
2. Beezer, Robert. *A First Course in Linear Algebra.* http://linear.ups.edu/
3. Judson, Tom, and Beezer, Robert. *Abstract Algebra: Theory and Applications*. http://abstract.ups.edu
4. Mezei, Razvan A.. *An Introduction to SAGE Programming: With Applications to SAGE Interacts for Numerical Methods*. Springer.
5. Kumar, Ajit, and Bist, Vikash. (2021). *Group Theory: An expedition with SageMath*, Narosa.

Course Code: MT-128
Course Title: Numerical Methods

Course Code: MT-128	**Course Category:Core Course (SEC-3)**
Course Title: Numerical Methods	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: The main objectives are: • The students will be able to understand the basic numerical analysis which is applicable to problems like finding of zeroes of algebraic equations.	

• interpolation, curve fitting and solution of first order differential equations. Students will also understand that when exact solutions are difficult to obtain, then approximate solutions can be obtained by using numerical methods. • The course is to equip students with the knowledge and skills necessary to effectively use numerical techniques to solve complex mathematical and scientific problems encountered in their respective fields of study	
Course Outcomes: After successful completion of this course students are expected to:	Cognitive level
• Understand basic concepts of methods of solutions of equations viz. bisection, iteration, Newton-Raphson methods and method of false position.	2
• Understand methods of curve fitting viz. Gauss's forward and backward difference formulae and Lagrange's interpolation formula.	2
• Use of curve fitting such as least square, polynomials and exponential fittings for set of given data.	3
• Find approximate solution of first order ODE by Taylor's series, Euler's method, Modified Euler's methods.	5

Course Content:

Unit-1. Solutions of Algebraic and Transcendental Equations **Hours-8, Marks-8**

1.1 Algebraic equations, transcendental equations, root of equations, rounding off numbers to n significant digits, rounding off numbers to n decimal places.

1.2 Type of errors: Inherent errors, truncation errors, absolute error, relative error and percentage error, absolute accuracy, relative accuracy.

1.3 The bisection method.

1.4 Regula-Falsi method

1.5 Newton-Rapson method.

Unit-2. Interpolation **Hours-7, Marks-7**

2.1 Introduction: Shift operator, forward differences, backward differences, averaging (Mean) operator, central differences and their relations.

2.2 Gauss's forward central difference formula. (Only Statement)

2.3 Gauss's backward central difference formula. (Only Statement)

2.4 Lagrange's interpolation formula with proof.

Unit-3. Fitting of Polynomials **Hours-7, Marks-7**

3.1 Least Square Method

3.2 Fitting of straight line $y = a + bx$

3.3 Fitting of second-degree polynomial $y = a + bx + cx^2$

3.4 Fitting of exponential function $y = ae^{bx}$

3.5 Fitting of logarithmic function $y = ax^b$

Unit-4. Numerical solutions of ordinary differential equations **Hours-8, Marks-8**

4.1 Taylor's series

4.2 Euler's method

4.3 Modified Euler's method

4.4 Runge-Kutta second order formula

Reference Books:

1. Sastry, S. S. (2012). *Introductory methods of numerical analysis*. PHI Learning Pvt. Ltd.
2. Vedamurthy, V. N., and Iyengar, N. (1998). *Numerical methods*. Vikas Publishing House Pvt Ltd.

3. Saxena, H. C. (1988). *Finite Differences and Numerical Analysis*. S. Chand Publishing.