Yogi Divine Society inspired,
Sarvodaya Kelavani Samaj managed

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot

(Autonomous)

Affiliated to Saurashtra University, Rajkot

Re-Accredited at 'A' Level by NAAC
STAR college Scheme & Status by MST-DBT
UGC- College with Potential for Excellence (CPE)
UGC-DDU KAUSHAL Kendra
GAAA – Highest Grade A-1 by KCG, Government of Gujarat
GPCB-Government of Gujarat approved Environment Audit Center
UGC-Autonomous College

DEPARTMENT OF MATHEMATICS

B.Sc. Mathematics

Enclosure-IA

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot (Autonomous)
Affiliated to Saurashtra University, Rajkot

Department of Mathematics
B.Sc. MATHEMATICS
Regulations for Students Admitted From A.Y. 2016-2017 & Onwards

ELIGIBILITY

Candidate who has passed 02 years Higher Secondary Certificate (10+2) examination with Science subjects in respective streams of Gujarat State or any other examination recognized as equivalent thereto with a good academic record, shall be eligible for admission, subject to such other conditions prescribed by the Saurashtra University and State Government from time to time. All admissions are provisional and subject to the approval of Saurashtra University.

DURATION OF THE PROGRAMME

The Programme shall extend over a period of three years comprising of six semesters with two semesters in one academic year. Each semester normally consists of 90 teaching days.

STRUCTURE OF THE PROGRAMME

Each UG programme shall have a curriculum comprising theory and practical courses with a specified syllabus. The curriculum of the programme is a blend of theory courses and practical courses as Core, Discipline Specific Electives (DSE) and Generic Electives (GE). In addition, project, internship/training and personality development courses as Ability Enhancement Courses (AEC) and Skill Enhancement Courses (SEC) shall be offered.

The medium of instruction and examinations shall be English except for courses on languages other than English.

EVALUATION

The evaluation shall generally comprise of Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) with percentage weightage as specified below, unless specified otherwise in the Scheme of Instruction and Examinations.

Theory Courses		***Practical Courses***	
Continuous Internal Evaluation (CIE)	30%	Continuous Internal Evaluation (CIE)	40%
Semester End Examination (SEE)	70%	Semester End Examination (SEE)	60%

For the purpose of computation of credits the following mechanism is adopted:

a) 1 hour instruction of Theory = 1 Credit
b) 1 hour instruction of Tutorial = 1 Credit
c) 2-3 hours instructions of Practical = 1 Credit

ISSUE OF MARK-SHEET AND DEGREE CERTIFICATE

The college shall publish the result after evaluation and with the recommendations of Result Passing Board at the end of each semester. On approval/ratification of the results by the Academic Council, the candidate will be recommended to Saurashtra University for the award of the degree on completion of all the courses and components of the curriculum.

Enclosure – IIA

Shree Manibhai Virani and Smt. Navalben Virani Science College, Rajkot (Autonomous)
Affiliated to Saurashtra University, Rajkot

Department of Mathematics
B.Sc. MATHEMATICS

OBJECTIVES OF THE PROGRAMME

The Curriculum is designed to attain the following learning goals which students shall accomplish by the time of their graduation:

Students under B.Sc. Mathematics programme should have acquired the following knowledge and skills:

1. Computational skills

a) Proficiency in basic computational methods including pure and applied branches of mathematics.
b) Facility with computer-aided computations.

2. Analytical skills

a) An understanding of the basic rules of logic and proficiency in using them.
b) The ability to distinguish a coherent argument from a fallacious one.
c) The ability to derive general principles from examples.
d) The ability to formulate mathematical conjectures and to test them.
e) The ability to complete mathematical proofs.

3. Practical problem solving and mathematical modeling skills

a) The ability to relate mathematical concepts to problems arising in other disciplines.
b) The ability to represent problems and ideas precisely in mathematical terms.
c) The ability to identify facts and techniques relevant to a given problem, and proficiency in using them to solve the problem.

4. Communication skills

a) The ability to clearly present mathematical concepts, statements, and arguments both in written and oral form.
b) Knowledge of standard mathematical terminology and notation and the ability to use them properly

5. Research Skills

a) A basic understanding of methods and the subject matter of various mathematical disciplines (including analysis, algebra, applied mathematics, and geometry).
b) The ability to read mathematical texts independently.
c) Comprehension of the general framework of mathematical research; an understanding of the role of axioms, assumptions, theorems, proofs, and conjectures.

SCHEME OF INSTRUCTION AND EXAMINATIONS
For students admitted from A.Y. 2016-2017 & onwards

Semester I							
Course Code	**Course**	**Hours of Instructions per week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Tot.**	
Part I							
16ULCEN01	Functional of English - I	3	3	40	60	100	3
Part II							
16UMTCC01	**Core 1:** Calculus	4	3	30	70	100	4
16UMTCC02	**Core 2:** Algebra	4	3	30	70	100	4
16UMTDA01	**DSE-Allied 1 :** Physics - I	3	3	30	70	100	3
16UMTCC03	**Core Practical 1:** Calculus and Plotting Practical	6*	3	20	30	50	3
16UMTCC04	**Core Practical 2:** Matrix Theory Practical	6*	3	20	30	50	3
16UMTDA02	**DSE-Allied Practical 1:** Physics Practical – I	2	3	20	30	50	1
		28				**550**	**21**
Part III							
	AECC-1 : Environmental Science	1	-	-	-		-
	SEC - 1: Value Education - I	1	-	Remarks			1
		30					

* 3hrs each on Day1 and Day 2.

Semester II							
Course Code	**Course**	**Hours of Instructions per week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Tot**	
Part I							
16ULCEN02	Functional of English - II	3	3	40	60	100	3
Part II							
16UMTCC05	**Core 3:** Differential Equation	4	3	30	70	100	4
16UMTCC06	**Core 4:** Advanced Calculus	4	3	30	70	100	4
16UMTDA03	**DSE-Allied 2 :** Physics - II	3	3	30	70	100	3
16UMTCC07	**Core Practical 3:** Differential Equation Practical	6*	3	20	30	50	3
16UMTCC08	**Core Practical 4 :** Introduction to GEOGEBRA Practical	6*	3	20	30	50	3
16UMTDA04	**DSE-Allied Practical 2:** Physics Practical – II	2	3	20	30	50	1
		28				**550**	**21**
Part III							
	AECC-1 : Environmental Science	1	-	Remarks			2
	SEC - 2: Value Education - II	1	-	Remarks			1
		30					

* 3hrs each on Day1 and Day 2.

Semester III							
Course Code	**Course**	**Hours of Instructions per week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Tot**	
Part I							
16ULCEN03	Advanced English Language – I	3	3	40	60	100	3
Part II							
16UMTCC09	**Core 5 :** Real Analysis	5	3	30	70	100	5
16UMTCC10	**Core 6 :** Linear Algebra-I	4	3	30	70	100	4
16UMTDA05	**DSE-Allied 3 :** Physics-III	3	3	30	70	100	3
16UMTCC11	**Core Practical 5 :** Real Analysis Practical	6*	3	20	30	50	3
16UMTCC12	**Core Practical 6 :** Introduction to Scilab Practical	6*	3	20	30	50	3
16UMTDA06	**DSE-Allied Practical 3 :** Physics Practical-III	2	3	20	30	50	1
		29				**550**	**22**

* 3hrs each on Day1 and Day 2.

Semester IV							
Course Code	**Course**	**Hours of Instructions per week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Tot**	
Part I							
16ULCEN04	Advanced English Language - II	3	3	40	60	100	3
Part II							
16UMTCC13	**Core 7 :** Discrete Mathematics	3	3	30	70	100	3
16UMTCC14	**Core 8 :** Linear Algebra-II	3	3	30	70	100	3
16UMTCC15	**Core 9 :** Complex Variable	3	3	30	70	100	3
16UMTDA07	**DSE-Allied 4 :** Physics-IV	3	3	30	70	100	3
16UMTCC16	**Core Practical 7 :** Advanced GEOGEBRA Practical	4	3	20	30	50	2
16UMTCC17	**Core Practical 8 :** Introduction to MAXIMA Practical	6*	3	20	30	50	3
16UMTDA08	**DSE-Allied Practical 4 :** Physics Practical-IV	2	3	20	30	50	1
		27				**650**	**21**

* 3hrs each on Day1 and Day 2.

Semester V							
Course Code	**Course**	**Hours of Instruc-tions per week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Tot.**	
Part II							
16UMTCC18	**Core 10 :** Programming in C	3	3	30	70	100	3
16UMTCC19	**Core 11 :** Group Theory	3	3	30	70	100	3
16UMTCC20	**Core 12 :** Numerical Analysis -I	3	3	30	70	100	3
16UMTCC21	**Core 13 :** Set theory and Logic (Self study course)	1	-	30	70	100	4
16UMTDC01/ 16UMTDC02/ 16UMTDC03	**DSE-Core 1:** Metric Space/ Number Theory/ Mechanics	3	3	30	70	100	3
16UMTCC22	**Core Practical 9 :** Programming in C Practical	4	3	20	30	50	2
16UMTCC23	**Core Practical 10 :** Numerical Analysis – I Practical	4	3	20	30	50	2
16UMTCC24	**Core Practical 11 :** Advanced SCILAB Practical	4	3	20	30	50	2
16UMTCC25	**Core 14:** Computer Based Test	-	2	100	-	100	1
	Generic Elective-I	2	-	100	-	100	2
	Group Project / Internship / Training	3	-	Evaluation in SEM.-6			-
		30				**850**	**25**

Semester VI							
Course Code	**Course**	**Hours of Instruc-tions per week**	**Exam Duration (Hours)**	**Maximum Marks**			**Credits**
				CIE	**SEE**	**Tot.**	
Part II							
16UMTCC26	**Core 15 :** Ring Theory	3	3	30	70	100	3
16UMTCC27	**Core 16 :** Optimization	3	3	30	70	100	3
16UMTCC28	**Core 17 :** Numerical Analysis –II	3	3	30	70	100	3
16UMTDC04/ 16UMTDC05/ 16UMTDC06	**DSE-Core 2:** Graph Theory / Complex analysis / Mathematical Modeling	3	3	30	70	100	3
16UMTCC29	**Core Practical 12:** Optimization Practical	4	3	20	30	50	2
16UMTCC30	**Core Practical 13:** Numerical Analysis -II Practical	4	3	20	30	50	2
16UMTCC31	**Core Practical 14 :** Introduction to SAGE Practical	4	3	20	30	50	2
	Generic Elective-II	2	3	100	-	100	2
16UMTCC32	Project / Internship / Training	4	1	60	40	100	2
		30				**750**	**22**
					Total Marks	**3900**	

Part III						
Course Code	**Semester**	**Particulars**	**Hrs of instruction/week**	**No. of Courses**	**Credit/ Course**	**Total Credits**
Ability Enhancement Compulsory Course (AECC)						
As per common list	I & II	**AECC-I** Environment Science	1	1	2	2
	IV & V	**AECC-II** Communication Skill/Soft Skills	2	2	1	2
					Sub Total	**4**
Skill Enhancement Course (SEC)						
As per common list	I	**SEC-I** Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any Semester between II - V	**SEC-II** *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	**SEC-III** **Value Added Courses	40 hours in total	1	1	1
				Sub Total		4
				Grand Total		8

***Co-Curricular Courses** - Option to students to choose 1 from a list of courses offered by the college, such as Add on Courses, Gandhian Studies Certificate Course, Women Studies Course, etc.

****Value Added Courses** - Option to student to choose at least 1 from a list of courses offered by UG departments.

TOTAL MARKS & CREDIT DISTRIBUTION

S.NO	PART	Total Marks	Total Credits
1.	**PART I:** Language Course	400	12
2.	**PART II:** CORE, DSE ALLIED DSE CORE, GE COURSES	3500	120
3.	**PART III:** AECC-I & II, SEC – I, II & III	Remarks	08
TOTAL		**3900**	**140**

- **PART – I LANGUAGE COURSE**

The following compulsory courses offered in the first to fourth semester.

S. No	Semester	Course code	Course
1.	**I**	16ULCEN01	Functional of English - I
2.	**II**	16ULCEN02	Functional of English - II
3.	**III**	16ULCEN03	Advanced English Language – I
4.	**IV**	16ULCEN04	Advanced English Language - II

- **PART – II CORE, DSE ALLIED DSE CORE, GE CORE COURSES [Theory]**

The Core Course given in First to Sixth semester is compulsory

S.No	Semester	Course code	Course
1.	**I**	16UMTCC01	Calculus
2.		16UMTCC02	Algebra
3.	**II**	16UMTCC05	Differential Equation
4.		16UMTCC06	Advanced Calculus
5.	**III**	16UMTCC09	Real Analysis
6.		16UMTCC10	Linear Algebra-I
7.	**IV**	16UMTCC13	Discrete Mathematics
8.		16UMTCC14	Linear Algebra-II
9		16UMTCC15	Complex Variable

10.	V	16UMTCC18	Programming in C
11.		16UMTCC19	Group Theory
12.		16UMTCC20	Numerical Analysis -I
13.		16UMTCC21	Set theory and Logic (Self study course)
14.		16UMTCC25	Computer Based Test (MCQs on fundamentals and principles of Core Courses up to V semester
15.	VI	16UMTCC26	Ring Theory
16		16UMTCC27	Optimization
17		16UMTCC28	Numerical Analysis – II

- **CORE COURSES [Practical]**

The Core Courses Practical given in First to Sixth semester is compulsory.

S.No	Semester	Course code	Course
1.	I	16UMTCC03	Calculus and Plotting Practical
2.		16UMTCC04	Matrix Theory Practical
3.	II	16UMTCC07	Differential Equation Practical
4.		16UMTCC08	Introduction to GEOGEBRA Practical
5.	III	16UMTCC11	Real Analysis Practical
6.		16UMTCC12	Introduction to SCILAB Practical
7.	IV	16UMTCC16	Advanced GEOGEBRA Practical
8.		16UMTCC17	Introduction to MAXIMA Practical
9.	V	16UMTCC22	Programming in C Practical
10.		16UMTCC23	Numerical Analysis–I Practical
11.		16UMTCC24	Advanced SCILAB Practical
12.	VI	16UMTCC29	Optimization Practical
13.		16UMTCC30	Numerical Analysis-II Practical
14.		16UMTCC31	Introduction to SAGE Practical

- **OTHER CORE COURSES**

S. No	Semester	Course Code	Course
1	V- VI	16UMTCC32	Group Project/ internship/Training

- **DSE ALLIED COURSES[Theory]**

The DSE allied Course Theory given in first to forth semester is compulsory.

S.No	Semester	Course code	Course
1.	I	16UMTDA01	Physics -I
2.	II	16UMTDA03	Physics -II
3.	III	16UMTDA05	Physics -III
4.	IV	16UMTDA07	Physics -IV

- **DSE ALLIED COURSES [Practical]**

The DSE allied Course Practical given in first to forth semester is compulsory.

S.No	Semester	Course code	Course
1.	I	16UMTDA02	Physics – I Practical
2.	II	16UMTDA04	Physics – II Practical
3.	III	16UMTDA06	Physics –III Practical
4.	IV	16UMTDA08	Physics –IV Practical

- **DSE CORE COURSE [Theory & Practical]**

Students are required to opt for any one of the courses offered in 5^{th} & 6^{th} semesters respectively.

S.No	Semester	Course code	Course
1.	**V**	16UMTDC01	Metric Space/
		16UMTDC02	Number Theory./
		16UMTDC03	Mechanics/
2.	**VI**	16UMTDC04	Graph Theory./
		16UMTDC05	Complex analysis./
		16UMTDC06	Mathematical Modeling.

- **GENERIC ELECTIVE**

S.N.	Semester	Course
1.	V	Any one course from the list of courses offered across UG departments
2.	VI	

- **AECC, SEC**

Part III						
Course Code	**Semester**	**Particulars**	**Hrs of instruction/week**	**No. of Courses**	**Credit/ Course**	**Total Credits**
Ability Enhancement Compulsory Course (AECC)						
As per common list	I & II	**AECC-I** Environment Science	1	1	2	2
	IV & V	**AECC-II** Communication Skill/Soft Skills	2	2	1	2
					Sub Total	**4**
Skill Enhancement Course (SEC)						
As per common list	I	**SEC-I** Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any Semester between II - V	**SEC-II** *Co-Curricular Course	> 40 hours in total	1	1	1
	Any Semester between II - V	**SEC-III** **Value Added Courses	40 hours in total	1	1	1
				Sub Total		4
				Grand Total		8

***Co-Curricular Courses** - Option to students to choose 1 from a list of courses offered by the college, such as Add on Courses, Gandhian Studies Certificate Course, Women Studies Course, etc.

****Value Added Courses** - Option to student to choose at least 1 from a list of courses offered by UG departments

Courses offered by the Mathematics department to UG students of the other departments.

I. DSE Allied Course [Theory]

S. No	Semester	Course Code	Course	Name of Program
1.	I	16UCADA01/ 16UITDA01	Mathematics and Statistics-I	B.C.A. & B.Sc. IT
2.	II	16UCADA02/ 16UITDA02	Mathematics and Statistics-II	B.C.A. & B.Sc. IT
3.	III	16UCHDA05	Mathematics-I	B.Sc. Chemistry
4.	IV	16UCHDA07	Mathematics-II	B.Sc. Chemistry
5	IV	16UBCDA07	Mathematics for Biologist	B.Sc. Biochemistry

II: DSE – Allied Courses [Practical]

S.N.	Semester	Course Code	Course	Name of Program
1.	I		No Practical	B.C.A. & B.Sc. IT
2.	II		No Practical	B.C.A. & B.Sc. IT
3.	III	16UCHDA06	Mathematics-I Practical	B.Sc. Chemistry
4	IV	16UCHDA08	Mathematics-II Practical	B.Sc. Chemistry
5	IV	16UBCDA08	Mathematics for Biologist Practical	B.Sc. Biochemistry

III. Generic Elective Course

No	Semester	Course Code	Course	Name of Program
1.	V	-	-	Any one course from list of courses offered across UG departments
2.	VI	-	-	

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Enclosure – IIA

B.Sc. Mathematics

SEMESTER – I			
16UMTCC01	**CORE 1: Calculus**	**4hrs/wk**	**4 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Verify the existence of limits and calculate the limit (if exist) of single variable function and utilize the concept of limit to verify the continuity of single variable function.
2. Compute the higher order derivatives of given functions.
3. State and prove Leibnitz rule and implement the rule to compute the nth derivative of given functions.
4. State and prove L'Hospital's rule for Indeterminate forms of limits and implement the L'Hospital's rule for limits to calculate the limit of function of single variable.

Unit 1: Limit and continuity of functions of one variable (10 hrs)

- Limit and continuity.
- Properties of limits.
- Properties of continuous function.
- Discontinuity.

Unit 2: Successive differentiation (10 hrs)

- Successive differentiation
  $e^{(ax+b)},\ a^{bx},\ (ax+b)^m,\ \log(ax+b),\ \sin(ax+b),\ \cos(ax+b),$
  $e^{ax}\sin(bx+c),\ e^{ax}\cos(bx+c)$
- Leibnitz's theorem and its application.

Unit 3: Reduction formula (9 hrs)

- Reduction formulae $\int_0^{\frac{\pi}{2}} \sin^m x dx,\ \int_0^{\frac{\pi}{2}} \cos^m x dx,\ \int_0^{\frac{\pi}{2}} \sin^m x \cos^n x dx\ \ (m,n \in N)$.

Unit 4: Mean value theorems and Taylor's theorem (10 hrs)

- Mean value theorems and its geometrical interpretations.
- Increasing decreasing functions.
- Expansion of functions -Taylor's Series and
- Method of expansion of a function by using Maclaurian's series.
- Expansions of standard functions, method of inversion.
- Expansion of a function by method of differentiation or integration.
- Method of expansion of implicit function by Maclaurian's series.

Unit 5: Indeterminate Forms **(9 hrs)**

- Indeterminate Forms including $\frac{0}{0}$, $\frac{\infty}{\infty}$, $0\times\infty$, $\infty-\infty$, 0^0 ,∞^0 ,1^∞
- L' Hospitals Rules for above indeterminate forms.

TEXT BOOKS: -

1. Shanti Narayan, P.K.Mittal,(2007) Differential Calculus, S. Chand & Company Ltd.
2. Harikrishna,Differential Calculus, Atlantic Publication.

REFERENCE BOOKS:-

1. James Stewart, Calculus, Sixth Edition.
2. M. J. Strauss, G. L. Bradley and K. J. Smith, (2007) Calculus (3rd Edition), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi,.
3. H. Anton, I. Bivens and S. Davis, Calculus (7th Edition), John Wiley.
4. Shanti Narayan and P.K. Mittal,(2006) Integral Calculus, S. Chand & Co.

Semester – I			
16UMTCC02	**CORE 2: Algebra**	**4hrs/wk**	**4 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Define and utilize the concept of matrix, Understand the concept of Rank of a matrix and compute the rank of a given matrix.
2. Solve the systems of linear equations using concept of matrix and elementary row operations, Understand the elementary row operations and utilize elementary row operations to obtain echelon forms of given matrix.
3. Understand equivalence relations and test whether given relation is an equivalence relation or not.

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Unit 1: Concept of a matrix (10 hrs)

- Introduction to matrices, different types **Algebra** of matrices.
- Operations on matrices.
- Theorems on matrices.
- Elementary operations on matrices and types of matrices.
- Symmetric and skew – symmetric matrices.
- Hermitian and skew-Hermitian matrices.

Unit 2: Rank of a matrix (10 hrs)

- Linear dependence and independence of row and column matrices.
- Row rank, column rank and rank of a matrix.
- Row Reduced Echelon form of a matrix and matrix inversion using it.

Unit 3: Cayley-Hamilton theorem (9 hrs)

- Eigen values, Eigen vectors and the characteristic equation of a matrix.
- Cayley-Hamilton theorem and its use in finding inverse of a matrix.

Unit 4: Application of matrices (9 hrs)

- Application of matrices in solving a system of simultaneous linear equations.
- Cramer's rule. Theorem of consistency of system of simultaneous linear equations.
- Diagonalization of a symmetric matrices.

Unit 5: Equivalence relations and Principles of Mathematical Induction (10 hrs)

- Equivalence relations.
- Functions, Composition of functions.
- Invertible functions, One to one correspondence and cardinality of a set.
- Well-ordering property of positive integers.

- Division algorithm, Divisibility and Euclidean algorithm.
- Congruence relation between integers.
- Principles of Mathematical Induction
- Statement of Fundamental Theorem of Arithmetic.

Text Books: -

1. Shanti Narayana and P.K. Mittal, Textbook of Matrices, S.Chand and Company Ltd, 11th Edition.
2. Edgar G. Goodaire and Michael M. Parmenter, (2005). Discrete Mathematics with Graph Theory, 3rd Edition, Pearson Education (Singapore) Pvt. Ltd., Indian Reprint**.**

Reference Books:-

1. Titu Andreescu and Dorin Andrica,(2006) Complex Numbers from A to Z, Birkhauser.
2. David C. Lay,(2007) Linear Algebra and its Applications (3rd Edition), Pearson Education Asia, Indian Reprint.

Semester – I			
16UMTCC03	**CORE PRACTICAL 1: Calculus And Plotting Practical**	**6hrs/wk**	**3 Credits**

Objectives: -

Upon completion of the course students will be able to

1. Understand the domain and range of given functions including polynomials, and hyperbolic functions and plot graph of the same using those domain and range.
2. Utilize the Leibnitz rule to compute the nth derivative of given functions.
3. Implement the L'Hospital's rule for limits to calculate the limit of function of single variable.
4. Verify the Mean Value Theorems for given real valued function in given domain.

List of Practical

1. Plotting of graphs of function of type the greatest integer function, even and odd positive integer.
2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
3. Graphs of Hyperbolic functions.
4. Evaluate n^{th} derivates of the given functions.
5. Examples based on applications of Leibnitz theorem.
6. Examples based on reduction formula.
7. Evaluate limit using L'Hospital rule.
8. Expansions of functions in infinite power series using Taylor's and Maclaurin's formula.
9. Geometrical interpretation of mean value theorem & verification of MVT.
10. Problems based on mean value theorem.

TEXT BOOKS: -

1. Shanti Narayan, P. K. Mittal, (2007) Differential Calculus, S. Chand & Company Ltd.
2. Shanti Narayan, P. K. Mittal, (2006) Integral Calculus, S. Chand & Company Ltd.

Semester – I			
16UMTCC04	**CORE PRACTICAL 2: Matrix Theory Practical**	**6hrs/wk**	**3 Credits**

Objectives: -

Upon completion of the course students will be able to

1. Understand and use Cayley-Hamilton theorem to find the inverse of the given matrix.
2. Utilize various methods including Gauss elimination method, Gauss Jorden method and Cramer's rule in order to solve the system of linear equations.
3. Solve various problems using the Principles of Mathematical Induction, Euclidean algorithm and Congruence relation.

List of Practical

1. Find inverse of a matrix by using Cayley-Hamilton theorem.
2. Solve the system of simultaneous linear equation by using Gauss elimination method.
3. Solve the system of simultaneous linear equation by using Gauss Jorden method.
4. Find inverse of a matrix by using Gauss Jordan method.
5. Find eigen value and eigen vector of a matrix.
6. Find RRE form and rank of a matrix.
7. Verify the Cayley-Hamilton theorem.
8. Solutions of system of linear equations using row operations and Cramer's rule.
9. Examples based on Principles of Mathematical Induction.
10. Examples based on Euclidean algorithm and Congruence relation.

TEXT BOOKS: -

1. Shanti Narayana and P.K. Mittal, Textbook of Matrices, S.Chand and Company Ltd, 11^{th} Edition.
2. Serge Lang, Introduction to Linear Algebra, Springer (India).

REFERENCE BOOKS:-

1. V Krishnamurthy, V P Mainra and J L Arora, Introduction To Linear Algebra, AFFILIATED EAST-WEST PRESS PVT. LTD.-NEW DELHI
2. K. B. Dutta, Matrix and Linear Algebra, Prentice Hall of India.

Semester – II			
16UMTCC05	**CORE 3: Differential Equations**	**4hrs/wk**	**4 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Identify, analyze and subsequently solve physical situations whose behavior can be described by ordinary differential equations, Define and formulate a differential equation from a given relation or physical situations.
2. Define, identify and solve the differential equations of first order and first degree including Bernoulli's differential equation and First Order Exact differential equation.
3. Define, identify and solve differential equations of first order and higher degree.
4. Define, identify and solve Linear differential equations of higher order.

Unit 1: Differential Equations of First Order and First Degree: (10 hrs)

- Definitions, formation of a differential equation
- Definition and method of solving **of Bernoulli's differential equation**
- **Definition and methods of solving of Exact** differential equation.

Unit 2: Differential equations of first order and higher degree: (9 hrs)

- Differential equations of first order and first degree
  - Solvable for x.
  - Solvable for y.
  - Solvable for p.
- Clairaut's form of differential equation
- Lagrange's form of differential equations.

Unit 3: Linear differential equations of higher order (10 hrs)

- Linear differential equations of higher order **with constant coefficients.**
- Operator D, Meaning of auxiliary equation.
- Roots of auxiliary equation and solution of auxiliary equation f(D)y = 0 for real roots and complex roots.
- Operator $^1/_D$. Solution of differential equations of the type f(D)y = X.
- Meaning of complimentary function(C.F.) and Particular integral(P.I.).
- Methods to obtain Particular integral(P.I.) when $X = e^{ax}$, $X = \sin(ax+b)$, $X = \cos(ax+b)$, $X = x^m$, $X = e^{ax}.V$.
- Application to geometry, mechanics and physics.

Unit 4: Linear Differential Equations with Variable Coefficients. (10 hrs)

- The homogeneous linear equation First method of solution.
- Second method of solution, method to find complementary function.
- Method to find the particular integral,
- The symbolic function $f(\theta)$ and $1/f(\theta)$ Integral corresponding to a term of the form x^{α} in the second member.

Unit 5: Partial Differential Equation (9 hrs)

- Definition. derivation of a partial differential equation by the elimination of constant.
- Derivation of a partial differential equation by the elimination of an arbitrary function.

TEXT BOOKS: -

1. M. D. Raisinghania, Ordinary & Partial Differential Equation, S. Chand and Co.
2. Differential equations by Dr. R. C. Shah, Books India Publications – 5 th edition

REFERENCE BOOKS: -

1. Introductory Course in Differential Equations, Danial A. Murray, Tata McGraw Hills Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand & Co.

Semester – II			
16UMTCC06	**CORE 4: Advanced Calculus**	**4hrs/wk**	**4 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Verify the existence of limits and calculate the limit (if exist) of function of several variable and utilize the concept of limit to verify the continuity of function of several variable.
2. Verify the differentiability of function of several variable and Compute the partial derivatives of given function of several variables.
3. State and prove Euler's Theorem and implement the same to compute problems related to the Euler's Theorem.
4. Determine the curvature, asymptotes, point of inflexions, concavity, convexity and the singular points of the given curve using partial derivative.

Unit 1: Limit continuity of function of several variable and partial derivative (10 hrs)

- Introduction to function of several variables.
- Rectangular and spherical neighbourhood of a point in R^n.
- Limit of function of several variables.
- Concept of iterated limit, limit and path.
- Continuity of function of several variables.

Unit 2: Differentiability of function of several variables-I (9 hrs)

- Directional derivatives, Introduction to partial derivatives.
- Different notations and its geometric interpretation.
- Higher order partial derivatives and problems.
- Differentiability of function of two variables.
- Theorems on differentiability conditions and converses.

Unit 3: Differentiability of function of several variables-II (10 hrs)

- Chain rule for differentiability.
- Homogeneous functions, Euler's theorem for homogeneous functions of two variable.
- Extreme values of functions of two variables and its theorems .
- Taylor's theorem for function of two variables.

Unit 4: Curvature . asymptotes and multiple points (10 hrs)

- Various formulae for curvature(formulae for Cartesian coordinates, parametric equations and Polar coordinates only).
- Newton's method for curvature at origin.
- Concavity, Convexity and point of inflexion.
- Asymptotes parallel to co-ordinate axes.
- Oblique type and algebraic methods.
- Rules for finding asymptotes.
- Multiple points, Types of double points.

Unit 5: Beta & Gamma Functions (9 hrs)

- Beta and Gamma functions and relation between them.
- Value $\int_{-\infty}^{\infty} e^{-x^2} dx$ as gamma function.
- Statement of Duplication formula(Legendre's Formula.)

TEXT BOOKS: -

1. J. P. Singh, Calculus, Ane Books Pvt. Ltd; Second edition
2. Shanti Narayan and P.K. Mittal,(2006) Integral Calculus, S. Chand & Co..

REFERENCE BOOKS:-

1. David V. Widder, Advanced Calculus, Prentice Hall of India Pvt Ltd.
2. Shantil Narayan, P.K. Mittal, A Course of Mathematical Analysis, S. Chand & Co.
3. Shanti Narayan and P.K. Mittal,(2007) Differential Calculus, S. Chand & Co.

Semester – II			
16UMTCC07	**CORE PRACTICAL 3: Differential Equations Practical**	**6hrs/wk**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Identify, analyze and subsequently solve physical situations whose behavior can be described by ordinary differential equations, Define and formulate a differential equation from a given relation or physical situations.
2. Define, identify and solve the differential equations of first order and first degree including Bernoulli's differential equation and First Order Exact differential equation.
3. Define, identify and solve differential equations of first order and higher degree.
4. Define, identify and solve Linear differential equations of higher order.

List of Practical

1. Solve the differential equations of order 1 and degree 1 & also higher degree.
2. Solve the differential equations of higher order and degree 1 with constant coefficients.
3. Solve the differential equations of higher order and degree 1 with variable coefficients.
4. To derive the differential equation from the given relation between x and y.
5. Solve the homogeneous differential equations.
6. Solve the non-homogeneous differential equations.
7. Solve the exact differential equations.
8. Solve the linear differential equations.
9. Solve the Bernouli's differential equations.
10. Find the orthogonal trajectories of the system of parabolas.

TEXT BOOKS: -

1. Rainville and Bedient, Elementary Differential Equations, Macmillan Publication.

REFERENCE BOOKS:-

1. Frank Ayres, Theory and problems on Differential Equations, McGraw Hill Book Co., New York.

Semester – II			
16UMTCC08	**CORE PRACTICAL 4 : Introduction To GeoGebra Practical**	**6hrs/wk**	**3 Credits**

Objectives:-

Upon completion of the course students will be able to

1. Understand and utilize the interface of the software GeoGebra including the file, edit, view & options menus and various tools from the tool bar.
2. Obtain the skill to draw various geometric figures including lines, functions and conics.
3. Understand the concept and usage of the slider in GeoGebra.
4. Understand and use the futures of the input bar in order to draw various graphs and utilize the input bar to enter various ready-made commands of GeoGebra.

List of Practical

1. Introduction and practice of usage of the file, edit, view & options menus.
2. Introduction and practice of usage of the tools from the tool bar (including move, point & line) and perform its practicals.
3. Introduction and practice of usage of the tools from the tool bar (including polygon, circle & conics tools) and perform its practicals.
4. Introduction and practice of usage of the tools (including measurement tool, transformation tool & text tool) and perform its practicals.
5. Drawing of geometric shapes (including triangles, quadrilaterals, polygons, circles,...etc).
6. Graphs of functions, straight line, polynomials, trigonometric, inverse trigonometric, conic sections (including circle, ellipse, parabola, hyperbola ...etc), using input bar and introduction to input commands.
7. Verification of important theorems of geometry, algebra and calculus using GeoGebra.
8. Practical Based on usage of slider.
9. Practical Based on usage of spreadsheet view including usage of plotting, functions using data from spreadsheet view.
10. Geometric constructions using various circle tools and reflect, rotate and translate tools.

TEXT BOOKS: -

1. Judith Hohenwarter and Markus Hohenwarter, Introduction to GeoGebra

REFERENCE BOOKS:-

1. Judith Hohenwarter and Markus Hohenwarter, The official manual of GeoGebra.