



**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

Integrated B.Sc.- M.Sc. Mathematics

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

Department of Mathematics
Integrated B.Sc.- M.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.

A candidate having the degree of B.Sc. Mathematics from any university recognized by UGC may get admission in the fourth year of this programme. But these students will get only a Degree in M.Sc. Mathematics and not 5 year Integrated B.Sc. - M.Sc Mathematics Degree.

DURATION OF THE PROGRAMME

The Programme shall extend over a period of five years comprising of ten semesters with two semesters in one academic year. Each semester normally consists of 90 teaching days. Examination shall be conducted as continuous internal assessment (CIA) as well as semester end examination (SEE).

Options of exit and entry:

I Option of exit after 1st 3 years of study

- On earning **total 146 credits** at the end of 1st 3 years of study a **B.Sc. Degree in Mathematics** will be given.

II Option of exit after 1st 4 years of study (Two certificates will be given)

- On earning **total 146 credits** at the end of 1st 3 years of study and
- On earning **56 credits** (addition to above mentioned total **146** credits, i.e. on earning **total 202 credits**) at the end of 4th year of study
- **B.Sc. Degree in Mathematics** and **PG Diploma in Mathematics** will be awarded.

III Total credits to earn 5 year Integrated PG Degree

- On earning **total 248 credits** at the end of all the 5 years of study a **B.Sc. and M.Sc. Degree** viz. 5 year Integrated **B.Sc. - M.Sc. Degree in Mathematics** will be given.

IV Option of Lateral entry in the fourth year

- Candidate entering in Fourth Year will have to earn **total 103 credits** and these students will get only **M.Sc. in Mathematics** and not 5 year Integrated B.Sc. - M.Sc Degree.
- Such candidates will not be permitted to exit at the end of fourth year of study.

STRUCTURE OF THE PROGRAMME

The Integrated B.Sc.- M.Sc. Mathematics 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 competency and skill development courses as Ability Enhancement Courses (AEC) and Skill Enhancement Courses (SEC) shall be offered. Project, internship/training courses will be compulsory between 4th and 5th semesters and during 9th and 10th semesters.

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.

<i>Theory Courses</i>		<i>Practical Courses</i>	
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:

- 1 hour instruction of Theory = 1 Credit
- 1 hour instruction of Tutorial = 1 Credit
- 2-3 hours instructions of Practical = 1 Credit

ISSUE OF MARK-SHEET AND DEGREE CERTIFICATE

The college shall declare the result after evaluation and with the recommendations of Result Passing Board at the end of each semester and issue the mark sheet for 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.

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**Department of Mathematics
Integrated B.Sc.- M.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 **Integrated B.Sc.- M.Sc. Mathematics** programme should have acquired the following knowledge and skills:

1. Research Skills

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

2. Computational skills

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

3. Analytical skills

- a) An understanding of the basic rules of logic and proficiency in using them.
- b) The ability to give counter examples to prove or disprove the derived/ existing results.
- c) The ability to distinguish a coherent argument from a fallacious one.
- d) The ability to derive general principles from examples.
- e) The ability to formulate mathematical conjectures and to test them.
- f) The ability to complete mathematical proofs.

4. 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.

5. 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

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							
16ILCEN01	Functional of English - I	3	3	40	60	100	3
Part II							
16IMTCC01	Core 1: Calculus	4	3	30	70	100	4
16IMTCC02	Core 2: Algebra	4	3	30	70	100	4
16IMTDA01	DSE-Allied 1 : Physics-I	3	3	30	70	100	3
16IMTCC03	Core Practical - 1: Calculus and Plotting Practical	6*	3	20	30	50	3
16IMTCC04	Core Practical - 2: Matrix Theory Practical	6*	3	20	30	50	3
16IMTDA02	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							
16ILCEN02	Functional of English - II	3	3	40	60	100	3
Part II							
16IMTCC05	Core 3: Differential Equation	4	3	30	70	100	4
16IMTCC06	Core 4: Advanced Calculus	4	3	30	70	100	4
16IMTDA03	DSE-Allied 2 : Physics-II	3	3	30	70	100	3
16IMTCC07	Core Practical - 3: Differential Equation Practical	6*	3	20	30	50	3
16IMTCC08	Core Practical - 4 : Introduction to GEOGEBRA Practical	6*	3	20	30	50	3
16IMTDA04	DSE-Allied Practical 2: Physics - II Practical	2	3	20	30	50	1
		28				550	21
Part III							
	AECC-2 : 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							
16ILCEN03	Advanced English Language – I	3	3	40	60	100	3
Part II							
16IMTCC09	Core 5 : Real Analysis	5	3	30	70	100	5
16IMTCC10	Core 6 : Linear Algebra-I	4	3	30	70	100	4
16IMTDA05	DSE-Allied 3 : Physics-III	3	3	30	70	100	3
16IMTCC11	Core Practical - 5 : Real Analysis Practical	6*	3	20	30	50	3
16IMTCC12	Core Practical - 6 : Introduction to Scilab Practical	6*	3	20	30	50	3
16IMTDA06	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							
16ILCEN04	Advanced English Language - II	3	3	40	60	100	3
Part II							
16IMTCC13	Core 7 : Discrete Mathematics	3	3	30	70	100	3
16IMTCC14	Core 8 : Linear Algebra-II	3	3	30	70	100	3
16IMTCC15	Core 9 : Complex Variable	3	3	30	70	100	3
16IMTDA07	DSE-Allied 4 : Physics-IV	3	3	30	70	100	3
16IMTCC16	Core Practical - 7 : Advanced GEOGEBRA Practical	4	3	20	30	50	2
16IMTCC17	Core Practical -8 : Introduction to MAXIMA Practical	6*	3	20	30	50	3
16IMTDA08	DSE-Allied Practical 4 : Physics Practical - IV	2	3	20	30	50	1
		27				650	21

Compulsory Project/ training of 4 weeks duration will be started in summer vacation period between 4th and 5th semester, and it will be evaluated at the beginning of 5th semester. The report of the same will be submitted and viva voce will be conducted at the beginning of 5th semester.

Semester V							
Course Code	Course	Hours of Instructions per week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Tot .	
Part II							
16IMTCC18	Core 10 : Programming in C	3	3	30	70	100	3
16IMTCC19	Core 11 : Group Theory	3	3	30	70	100	3
16IMTCC20	Core 12 : Numerical Analysis -I	3	3	30	70	100	3
16IMTCC21	Core 13 : Set theory and Logic (Self study course)	1	-	100	-	100	4
16IMTDC01/ 16IMTDC02/ 16IMTDC03	DSE-Core 1: Metric Space/ Number Theory/ Mechanics	3	3	30	70	100	3
16IMTCC22	Core Practical - 9 : Programming in C Practical	4	3	20	30	50	2
16IMTCC23	Core Practical - 10 : Numerical Analysis – I Practical	4	3	20	30	50	2
16IMTCC24	Core Practical - 11 : Advanced SCILAB Practical	4	3	20	30	50	2
16IMTCC25	Core 14: Computer Based Test (for core courses from 1 st to 5 th sem)	-	2	100	-	100	1
16IMTCC26	Core 15: Group Project/ Training	In the vacation after sem IV	-	60	40	100	6
	**Generic Elective-I (from common UG Pool)	2	-	100	-	100	2
		27				950	31

**From the common pool of UG disciplines.

Semester VI							
Course Code	Course	Hours of Instructors per week	Exam Duration (Hours)	Maximum Marks			Credits
				CIE	SEE	Tot.	
Part II							
16IMTCC27	Core 16 :Analysis – II & Ring Theory	5	3	30	70	100	5
16IMTCC28	Core 17 : Optimization	3	3	30	70	100	3
16IMTCC29	Core 18 : Numerical Analysis –II	3	3	30	70	100	3
16IMTDC04/ 16IMTDC05/ 16IMTDC06	DSE-Core 2: Graph Theory / Complex analysis / Mathematical Modeling	3	3	30	70	100	3
16IMTCC30	Core Practical - 12: Optimization Practical	4	3	20	30	50	2
16IMTCC31	Core Practical - 13: Numerical Analysis -II Practical	4	3	20	30	50	2
16IMTCC32	Core Practical - 14 : Introduction to SAGE Practical	4	3	20	30	50	2
Common Code	**Generic Elective-II (From common UG Pool)	2	3	100	-	100	2
		28				650	22
TOTAL OF SEMESTERS I to VI		Total Marks				3900	

**From the common pool of UG disciplines.

Generic Electives offered by mathematics department:-

Course Code	Course	Hours of Instructors per week	Exam Duration (Hours)	Maximum Marks	Credits
16IMAGE01	Statistics	2	3	100	2
16IMAGE02	Probability & Distribution	2	3	100	2

Semester - VII							
Course Code	Course	Hrs of Inst/ week	Exam Duration (Hrs)	Max Marks			Credit
				CIA	SEE	Total	
Part –II							
16IMTCC33	Core 19: Algebra – I	4	3	30	70	100	4
16IMTCC34	Core 20: Topology – I	4	3	30	70	100	4
16IMTCC35	Core 21: Functions of Several Variables	4	3	30	70	100	4
16IMTCC36	Core 22: Theory of Differential Equations	4	3	30	70	100	4
16IMTDC07/ 16IMTDC08	DSE ID 3: Classical Mechanics–I/ Fuzzy Mathematics	4	3	30	70	100	4
16IMTDA09	DSE - ID - 5: Basic Computer Application	3		30	70	100	3
16IMTDA10	DSE - ID Practical - 5 Basic Computer Application	2		20	30	50	1
		25				650	24
Part III							
	**Professional Certification Course	#	-				2
Total		25					26

Out of regular class hours.

** Professional Certification Course from basket of choices offered by the college.

Semester – VIII							
Course Code	Course	Hrs of Inst/ week	Exam Duration (Hrs)	Max Marks			Credit
				CIA	SEE	Total	
Part II							
16IMTCC37	Core 23: Algebra – II	4	3	30	70	100	4
16IMTCC38	Core 24: Topology – II	4	3	30	70	100	4
16IMTCC39	Core 25: Real Analysis	4	3	30	70	100	4
16IMTCC40	Core 26: Theory of Partial Differential Equations.	4	3	30	70	100	4
16IMTDC09/ 16IMTDC10	DSE Core- 4: Classical Mechanics – II / Mathematical Methods	4	3	30	70	100	4
16IMTCC41	Core 27 : Life and work of Mathematicians*. (Self study course)	1	-	100	-	100	4
16IMTDA11	DSE - ID - 6: Web Development	3		30	70	100	3
16IMTDA12	DSE - ID - 6 : Practical Web Development	2		20	30	50	1
	**Generic Elective – III	2	-	100	-	100	2
Total		28				850	30

*e.g.:- To prepare an extended essay and presentation on the life and work of a mathematician.

** from common option list among PG depts.

Generic Elective offered by mathematics department:-

Course Code	Course	Hrs of Ins	Exam Duration (Hours)	Maximum Marks	Credits
16IMTGE03	Introduction to Latex.	2	3	100	2

Semester – IX							
Course Code	Course	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit
				CIA	SEE	Total	
Part II							
16IMTCC42	Core 28: Complex Analysis	4	3	30	70	100	4
16IMTCC43	Core 29: Number Theory – I	4	3	30	70	100	4
16IMTCC44	Core 30: Discrete Mathematics	4	3	30	70	100	4
16IMTCC45	Core 31: Linear Algebra	4	3	30	70	100	4
16IMTDC11/ 16IMTDC12	DSE ID - 5: Financial Mathematics / Cryptography	4	3	30	70	100	4
16IMTCC46	Group Project / Training /	3	-	Evaluated at the end of Sem-X			-
Total		23				500	20

Semester – X							
Course Code	Course	Hrs of Inst	Exam Duration (Hrs)	Max Marks			Credit
				CIA	SEE	Total	
Part – II							
16IMTCC46	Core 32: Functional Analysis	4	3	30	70	100	4
16IMTCC47	Core 33: Number Theory – II	4	3	30	70	100	4
16IMTCC48	Core 34: Graph Theory	4	3	30	70	100	4
16IMTCC49	Core 35: Differential Geometry	4	3	30	70	100	4
16IMTDC13/ 16IMTDC14	DSE ID - 6: Mathematical Statistics / Operation Research	4	3	30	70	100	4
16IMTCC50	Group Project/ Training	3	-	60	40	100	5
Part – II							
16IMTCE01	Writing Summery of a Research Paper	-	-	50	-	50	1
Total		23				650	26
TOTAL OF SEMESTERS : VII to X						2650	102

Part III						
Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/Course	Total Credits
<i>Ability Enhancement Compulsory Course (AECC)</i>						
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
<i>Skill Enhancement Course (SEC)</i>						
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.

56 Credits

A PG Diploma Certificate in Mathematics will be given

III Total credits to earn 5 year Integrated PG Degree

Part I & II 138+100 = 238 Credits
Part III 8+2 = 10 Credits

248 Credits

A Single PG Degree viz. 5 year Integrated M.Sc. Degree in Mathematics will be given.

IV Option of Lateral entry in the fourth year

Candidate entering in Fourth Year will have to complete the following

a) Courses of 7th - 10th semester = 100 Credits
b) Certificate Course = 2 Credits
c) Value Education (Course of other PG Programme) = 1 Credits

103 Credits

Part II - 100 Credits
Part III * - 3 Credits

Total - 103 Credits

* Professional Certificate – 2 Credits & Value Education – 1 Credit.

Note: These students will get only M.Sc. in mathematics and 5 year Integrated B.Sc. - M.Sc Mathematics Degree.

● **PART – I LANGUAGE COURSE**

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

S. No	Semester	Course code	Course
1.	I	16ILCEN01	Functional of English - I
2.	II	16ILCEN02	Functional of English - II
3.	III	16ILCEN03	Advanced English Language – I
4.	IV	16ILCEN04	Advanced English Language - II

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

The Core Course given in First to Tenth semester is compulsory

S. No	Semester	Course code	Course
1.	I	16IMTCC01	Calculus
2.		16IMTCC02	Algebra
3.	II	16IMTCC05	Differential Equation
4.		16IMTCC06	Advanced Calculus

5.	III	16IMTCC09	Real Analysis
6.		16IMTCC10	Linear Algebra-I
7.	IV	16IMTCC13	Discrete Mathematics
8.		16IMTCC14	Linear Algebra-II
9.		16IMTCC15	Complex Variable
10.	V	16IMTCC18	Programming in C
11.		16IMTCC19	Group Theory
12.		16IMTCC20	Numerical Analysis -I
13.		16IMTCC21	Set theory and Logic (Self study course)
14.		16IMTCC25	Computer Based Test (MCQs on fundamentals and principles of Core Courses up to semester - V
15.		16IMTCC26	Project/ Training
16.		VI	16IMTCC27
17.	16IMTCC28		Optimization
18.	16IMTCC29		Numerical Analysis – II
19.	VII	16IMTCC33	Algebra – I
20.		16IMTCC34	Topology – I
21.		16IMTCC35	Functions of Several Variables
22.		16IMTCC36	Theory of Differential Equations
23.	VIII	16IMTCC37	Algebra – II
24.		16IMTCC38	Topology – II
25.		16IMTCC39	Real Analysis
26.		16IMTCC40	Theory of Partial Differential Equations
27.		16IMTCC41	Life and work of Mathematicians*. (Self study course)
28.	IX	16IMTCC42	Complex Analysis
29.		16IMTCC43	Number Theory – I
30.		16IMTCC44	Discrete Mathematics
31.		16IMTCC45	Linear Algebra
32.	X	16IMTCC46	Functional Analysis
33.		16IMTCC47	Number Theory – II
34.		16IMTCC48	Graph Theory
35.		16IMTCC49	Differential Geometry

- **CORE COURSES [Practical]**

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

S. No	Semester	Course code	Course
1.	I	16IMTCC03	Calculus and Plotting Practical
2.		16IMTCC04	Matrix Theory Practical
3.	II	16IMTCC07	Differential Equation Practical
4.		16IMTCC08	Introduction to GEOGEBRA Practical
5.	III	16IMTCC11	Real Analysis Practical
6.		16IMTCC12	Introduction to SCILAB Practical
7.	IV	16IMTCC16	Advanced GEOGEBRA Practical
8.		16IMTCC17	Introduction to MAXIMA Practical
9.	V	16IMTCC22	Programming in C Practical
10.		16IMTCC23	Numerical Analysis–I Practical
11.		16IMTCC24	Advanced SCILAB Practical
12.	VI	16IMTCC30	Optimization Practical
13.		16IMTCC31	Numerical Analysis-II Practical
14.		16IMTCC32	Introduction to SAGE Practical
-	VII	-	-
-	VIII	-	-
-	IX	-	-
-	X	-	-

- **Other core courses**

S. No	Semester	Course Code	Course
1.	Summer Vacation Period between Semester IV and V	16IMTCC26	Group Project/ Training
2.	IX, X	16IMTCC46	Group Project/ 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	16IMTDA01	Physics-I
2.	II	16IMTDA03	Physics-II
3.	III	16IMTDA05	Physics -III
4.	IV	16IMTDA07	Physics -IV
5.	VII	16IMTDA09	Basic Computer Application
6.	VIII	16IMTDA11	Web Development

• 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	16IMTDA02	Physics Practical – I
2.	II	16IMTDA04	Physics Practical – II
3.	III	16IMTDA06	Physics Practical –III
4.	IV	16IMTDA08	Physics Practical –IV
5.	VII	16IMTDA10	Basic Computer Application
6.	VIII	16IMTDA12	Web Development

• DSE CORE COURSE [Theory & Practical]

Students are required to opt for any one of the courses offered in 5th to 10th semesters respectively.

S. No	Semester	Course code	Course
1.	V	16IMTDC01	Metric Space/
		16IMTDC02	Number Theory. /
		16IMTDC03	Mechanics/
2.	VI	16IMTDC04	Graph Theory. /
		16IMTDC05	Complex analysis. /
		16IMTDC06	Mathematical Modeling.
3	VII	16IMTDC07	Classical Mechanics - I
		16IMTDC08	Fuzzy Mathematics
4.	VIII	16IMTDC09	Classical Mechanics - II
		16IMTDC10	Mathematical Methods
5.	IX	16IMTDC11	Financial Mathematics
		16IMTDC12	Cryptography
6.	X	16IMTDC13	Mathematical Statistics
		16IMTDC14	Operation Research

Part- II COMPETENCY ENHANCEMENT COURSES

S. No	Semester	Course Code	Course
1.	VII	-	-
2.	VIII	-	-
3.	IX	-	-
4.	X	16IMTCE01	Writing Summery of a Research Paper

• **Part III VALUE EDUCATION**

1.	VII	-	Value Education
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I. Generic Elective Course

S. No	Semester	Course Code	Course	Name of Course
1.	V	-	-	Any one course from list of courses offered across UG departments
2.	VI	-	-	
3.	VIII	-	-	Any one course from list of courses offered across the departments offering integrated programmes.

• **PART – III: - AECC, SEC**

Part III						
Course Code	Semester	Particulars	Hrs of instruction/week	No. of Courses	Credit/ Course	Total Credits
<i>Ability Enhancement Compulsory Course (AECC)</i>						
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
<i>Skill Enhancement Course (SEC)</i>						
As per common list	I	SEC-I Value Education-I	1	1	1	1
	II	Value Education-II	1	1	1	1
	Any	SEC-II *Co-	> 40 hours in	1	1	1

	Semester between II - V	Curricular Course	total			
	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.	III	16ICHDA05	Mathematics-I	B.Sc. Chemistry
2.	IV	16ICHDA07	Mathematics-II	B.Sc. Chemistry

II: DSE – Allied Courses [Practical]

S.N.	Semester	Course Code	Course	Name of Program
1.	III	16ICHDA06	Mathematics-I Practical	B.Sc. Chemistry
2	IV	16ICHDA08	Mathematics-II Practical	B.Sc. Chemistry

5 Year B.Sc. - M.Sc. (Integrated) Mathematics

SEMESTER – I			
16IMTCC01	CORE 1: Calculus	4hrs/wk	4Credits

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			
16IMTCC02	CORE 2: Algebra	4hrs/week	4Credits

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.

Unit 1: Concept of a matrix (10hrs)

- 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 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 Narayan 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			
16IMTCC03	CORE PRACTICAL 1: Calculus And Plotting Practical	6hrs/wk	3Credits

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} derivatives of the given functions.
5. Examples based on applications of Leibnitz theorem.
6. Examples based on reduction formula.
7. Evaluate limit using L'Hospital's 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			
16IMTCC04	CORE PRACTICAL 2: Matrix Theory Practical	6hrs/wk	3Credits

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 Jordan 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 Jordan 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 Narayan and P.K. Mittal, Textbook of Matrices, S.Chand and Company Ltd, 11th 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			
16IMTCC05	CORE 3: Differential Equations	4hrs/wk	4Credits

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 $X = e^{ax}$, $X = \sin(ax+b)$, $X = \cos(ax+b)$, $X = x^m$, $X = e^{ax} \cdot V$.
- 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 – 5th 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			
16IMTCC06	CORE 4: Advanced Calculus	4hrs/wk	4Credits

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, and 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 variables.
- 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. Shanti 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			
16IMTCC07	CORE PRACTICAL 3: Differential Equations Practical	6hrs/wk	3Credits

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:-

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

Semester – II			
16IMTCC08	CORE PRACTICAL 4 : Introduction To GeoGebra Practical	6hrs/wk	3Credits

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.

Semester – VII			
16IMTCC33	Core 1: Algebra – I	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand basic principles of algebraic structures like groups, fields rings and division rings.
2. Recognize and understand the concept of Ideals.
3. Recognize and understand the concepts of Euclidean domains, Unique factorization domains, polynomial rings as well as Einstein irreducibility criterion.

Unit 1 Basic concepts of group theory (10hrs)

- Group
- Abelian group
- Cyclic group
- Normal subgroup

Unit 2 Homomorphism of Groups (10hrs)

- Quotient group
- Permutation group
- Group isomorphism and their properties
- CAYLEY’S theorem, Automorphisms of groups

Unit 3 Direct Products (10hrs)

- Direct Products
- Finitely Generated Abelian Groups
- Invariants of a finite Abelian Groups
- Sylow Theorems

Unit 4 Quick look at basic ring theory (9hrs)

- Euclidean ring
- Quotient ring and zero divisors
- Ideals and ideal rings
- Principal ideal
- Maximal ideal and prime ideal
- Homomorphisms of ideals
- Sum and Direct Sum of Ideals
- Nilpotent and Nil Ideals

Unit 5 Euclidean domains (9hrs)

- Euclidean domains

- Principal Ideal Domains
- Unique Factorization Domains
- Polynomial Rings over UFD
- Polynomial rings over rational field
- Irreducible polynomials
- Einstein irreducibility criterion

Reference Books:

- 1) P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, Second Edition, Cambridge University Press, 1995.
- 2) M. Artin, Algebra, Prentice-Hall of India Private Ltd., New Delhi, 1994.
- 3) J. A. Gallian, Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House, New Delhi, 1999.
- 4) N. S. Gopalakrishnan, University Algebra, New Age International Private Ltd. Publishers, New Delhi, Sixth Reprint, 1998.
- 5) I. N. Herstein, Topics in Algebra, Second Edition, Wiley Pub. , New York, 1975.

Semester – VII			
16IMTCC34	Core 2: Topology – I	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Recognize and interpret the topological structures and their characterizations.
2. Identify and understand the subspace topology and product topology.
3. Identify and classify the type of topology including quotient topology and metric topology.
4. Understand and differentiate the hierarchy of the topological spaces and their characterizations.

Unit 1 Topological spaces (10hrs)

- Relations and well ordered set
- Topological spaces
- Basis for a Topology

Unit 2 The Subspace Topology (10hrs)

- The Subspace Topology
- Order Topology

Unit 3 Product Topology (10hrs)

- Product Topology and related concepts
- Closed sets and limit points

Unit 4 Continuity (9hrs)

- Continuous functions
- Metric Topology
- Quotient Topology

Unit 5 Hierarchy in topological spaces (9hrs)

- T_1 - spaces
- Hausdorff spaces
- Regular spaces and Normal spaces
- Urysohn's Lemma and Tietze extension theorem

Reference Books:-

- 1) Munkres J., Topology: A first course, Prentice-Hall of India Pvt. Ltd, New Delhi.
- 2) Simmons G. F., Introduction to Topology and Modern Analysis, McGraw Hill Company, Tokyo.
- 3) Willards S., General Topology, Addition-Wesley, Reading, 1970.

Semester – VII			
16IMTCC35	Core 3: Functions of Several Variables	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Identify and define functions of the form $T: \mathbb{R}^n \rightarrow \mathbb{R}^m$
2. Introduce the concepts including limit, continuity for the functions of several variables.
3. Understand and criticize the concepts of partial derivative of first and higher order for functions of several variables.
4. Recognize and understand the concepts of tensor algebra on finite dimensional vector spaces, alternating and symmetric tensors, wedge products, vector fields and forms as well as their basic properties.

Unit 1 Euclidean Space and its basic properties (10hrs)

- Euclidean Space \mathbb{R}^n and its basic properties
- Functions From: $\mathbb{R}^n \rightarrow \mathbb{R}^m$
- Limit, Continuity and Oscillation
- Relation between Linear Transformation $T: \mathbb{R}^n \rightarrow \mathbb{R}^m$ and $m * n$ Matrices

Unit 2 Differentiation (10hrs)

- Differentiations and their Basic Properties
- Chain Rule and Jacobian Matrix

Unit 3 Partial Differentiation (10hrs)

- Partial Derivatives and its Relation with Jacobian Matrix
- Partial Derivatives of Higher Order

Unit 4 Partial Derivative and Continuity (9hrs)

- Young's Theorem, and Schwarz's Theorem
- Directional Derivative its Basic Properties its Relation with Derivative
- Partial Derivative and Continuity

Unit 5 Tensor algebra on Finite Dimensional Vector Space (9hrs)

- Tensor algebra on Finite Dimensional Vector Space
- Alternating and Symmetric Tensors
- Wedge Product and Relation Among Them
- Vector Fields and Forms, their Basic Properties

Reference Books:-

- 1) M. Spivak, Calculus on Manifolds, W.E. Benjamin Inc., 1965.
- 2) W. Rudin, Principles of Mathematical Analysis, (Third Edition), Tata McGraw-Hill Publ. Co., New Delhi, 1983.
- 3) S. R. Ghorpade and B. V. Limaye, A Course in Multivariable Calculus and Analysis, Springer, 2010

Semester – VII			
16IMTCC36	Core 4: Theory of Differential Equations	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand the meaning of Ordinary Differential Equations.
2. Understand and solve Partial differential equation.
3. Identify and solve Gauss hyper geometric equation.
4. Understand, identify and solve Cauchy Problem including Charpit's and Jacobi's method.

Unit 1 Review of Simultaneous Ordinary Differential Equations (10hrs)

- Review of Simultaneous Ordinary Differential Equations of First Order
- Second order differential equations: the method of variation of parameters
- Ordinary and singular points, series solution
- Fresenius method: solution in series near regular singular point, point at infinity

Unit 2 Some special kind of equations (10hrs)

- Legendre equation
- Legendre polynomial and its properties
- Bessel's equation
- Bessel's function of first and second kind and their properties

Unit 3 Partial differential equations (10hrs)

- Partial differential equation
- Partial differential equation of first order
- Compatible system of first order partial differential equations
- Picard's Method of successive Approximations

Unit 4 Gauss hyper geometric equations (9hrs)

- Gauss hyper geometric equation
- Gauss hyper geometric function and its properties

Unit-5 Solution of partial differential equations (9hrs)

- Charpit's and Jacobi's method
- Cauchy Problem

Reference Books:-

- 1) G. F. Simmons, Differential equations with applications and historical notes, McGraw-Hill International Editions, second edition.
- 2) Amarnath, T., Elementary Course in Partial Differential Equations, Narosa Publ. House, New Delhi, 1997.
- 3) Sneddon, I. N., Elements of Partial Differential Equations, McGraw-Hill Publ. Co., 1957.

- 4) Rabenstein, A. L., Introduction to Ordinary Differential Equations, Academic Press.
- 5) Raisinghania, M. D. Advanced Differential Equations, S. Chand & Co., 1995.
- 6) Grewal, B.S. and Grewal, J.S., Higher Engineering Mathematics, (36th Edition), Khanna Publ., New Delhi, 2000.
- 7) Somasundaram, D., Ordinary Differential Equations: A First Course, Narosa Publ. House, New Delhi, 2002.

Semester – VII			
16IMTDC07	DSE-3 : Classical Mechanics - I	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand and describe elementary principles of motion.
2. Understand and criticize equations of motion and classify the dynamical systems.
3. Derive and utilize Lagrange's equation of motions.
4. Identify, understand and solve two body central force problem.

Unit 1 Survey of elementary principles (10hrs)

- Conservation theorem for linear momentum and angular momentum for a particle
- Conservation theorem for linear momentum and angular momentum for a system of particles
- Classification of dynamical system

Unit 2 D'Almbert's principle and Lagrange's equation of motions (10hrs)

- Constraints.
- Virtual displacement and principle of virtual work.
- Generalized force in holonomic system
- Mathematical expression for principle of virtual work
- D'Almbert's principle
- Lagrange's equation for holonomic system
- Lagrange's equation for conservative non-holonomic system
- Problems on above topics

Unit 3 Variational principle and Lagrange's equations (10hrs)

- Variational principle
- Calculus of variations
- Hamilton's principle
- Derivation of Hamilton's principle from Lagrange's equation
- Derivation of Lagrange's equations from Hamilton's principle
- Cyclic co-ordinates
- Conservation theorems
- Problems on above topics

Unit 4 Two Body Central force problem (9hrs)

- Reduction to equivalent one body problem
- The equations of motion and first integrals
- The equivalent one dimensional problem and classification of orbits
- The inverse square law of force

Unit 5 Equations of Motion and Rigid bodies

- Independent co-ordinates of rigid bodies
- Generalized co-ordinates of a rigid bodies
- Euler angles and Cayley-Klein parameters and related quantities
- Components of angular velocity along the body set of axes
- Euler's theorem on the motion of a rigid body, rate of change of a vector
- The coriolis force
- Euler's equations of motion for a rigid body
- Finite rotations
- Infinitesimal rotations

Reference Books:-

- 1) H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House
- 2) C. R. Mondal, Classical Mechanics, Prentice Hall of India Pvt. Ltd.

Semester – VII			
16IMTDC08	DSE- 3 Fuzzy Mathematics	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Recognize and understand concepts of fuzzy sets and their types.
2. Understand and utilize operations on fuzzy sets.
3. Identify, understand and solve fuzzy relation equations.

Unit 1 Fuzzy sets (10hrs)

- Fuzzy sets – and their basic types
- Basic concepts , α -cuts ,Additional properties of α -cuts
- Extension principle for Fuzzy sets

Unit 2 Operations on Fuzzy sets (10hrs)

- Operations on Fuzzy sets and Types of operations
- Fuzzy complements
- t-Norms
- Fuzzy Unions
- Combinations of operations

Unit 3 Fuzzy Arithmetic (10hrs)

- Fuzzy numbers
- Arithmetic operations on intervals
- Arithmetic operations on Fuzzy numbers

Unit 4 Fuzzy relations (9hrs)

- Binary fuzzy relations
- Fuzzy equivalence relations
- Fuzzy compatibility relations
- Fuzzy ordering relations
- Fuzzy morphisms

Unit 5 Fuzzy Relation Equations (9hrs)

- Fuzzy Relation Equations General discussion
- Problem partitioning, Solution method
- Fuzzy Relation Equations based on Sup- \circ Compositions – Fuzzy Relation Equations based on inf- \circ Compositions

Reference Books:

- 1) George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 2004.
- 2) H.J. Zimmermann, Fuzzy Set Theory and its Applications, Allied Publishers Limited, New Delhi, 1991.
- 3) G. J. Klir and B. Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 1995.

Semester – VIII			
16IMTCC37	Core 5: Algebra – II	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. List and understand advance concepts of Algebra.
2. Identify, define and perform operations on modules.
3. Define and verify automorphisms and homomorphism of modules.

Unit 1 Division ring and Field (10hrs)

- Division ring and Field
- Extension fields
- Algebraic and transcendental extensions

Unit 2 Exetensions (10hrs)

- Splitting fields
- Normal extensions
- Multiple roots
- Finite fields
- Separable extensions

Unit 3 Automorphism fixed fields (10hrs)

- Automorphism fixed fields
- Galois extension
- Fundamental theorem of Galois Theory
- Fundamental theorem of Algebra

Unit 4 Modules (9hrs)

- Modules (Definitions and examples)
- Submodules and Operation on modules

Unit 5 Homomorphism of Modules (9hrs)

- Homomorphisms of modules and quotient modules
- Completely reducible module
- Finitely generated modules

Reference Books:

- 1) P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, Second Edition, Cambridge University Press, 1995.
- 2) M. Artin, Algebra, Prentice-Hall of India Private Ltd., New Delhi, 1994.
- 3) J. A. Gallian, Contemporary Abstract Algebra, Fourth Edition, Narosa Publishing House, New Delhi, 1999.
- 4) N. S. Gopalakrishnan, University Algebra, New Age International Private Ltd. Publishers, New Delhi, Sixth Reprint, 1998.
- 5) I. N. Herstein, Topics in Algebra, Second Edition, Wiley Pub. , New York, 1975.

Semester – VIII			
16IMTCC38	Core 6: Topology – II	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand, define and verify connectedness of topological spaces.
2. Understand, define and verify nets and filters.
3. State and prove the Tychonoff's theorem.
4. List, compare and classify the separation axioms of topological spaces.
5. Understand, define and verify concept of compact spaces.

Unit 1 Connected Spaces (10hrs)

- Connected spaces
- Components
- Path components

Unit 2 Nets and Filters (10hrs)

- Nets and Filters
- Tychonoff's theorem

Unit 3 Product and quotient topologies (10hrs)

- The product and quotient topologies
- Separation properties in products and quotient spaces

Unit 4 Compact spaces (9hrs)

- Compact spaces
- Product and quotient of compact spaces

Unit 5 Locally compactness (9hrs)

- Limit point and Compactness
- Locally compactness

Reference Books:-

- 1) Munkres J., Topology: A first course, Prentice Hall of India Pvt. Ltd, New Delhi.
- 2) Kelly J. L., General Topology, Van Nostrand Reinhold Company, 1965.
- 3) Willards S., General Topology, Addition-Wesley, Reading, 1970.

Semester – VIII			
16IMTCC39	Core 7: Real Analysis	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand, define algebra of sets.
2. Define and understand measurable sets and various types of measures.
3. Define, understand and utilize the concept of differentiation of monotone functions and absolute continuity.
4. State and prove theorems including Holder's inequality and Minkowski's inequality.

Unit 1 Algebra of Sets (10hrs)

- Algebra of sets, σ -algebra of sets
- Borel sets
- Lebesgue outer measure
- Measurable sets
- Lebesgue measure

Unit 2 Nonmeasurable Set (10hrs)

- A nonmeasurable set
- Measurable Functions
- Littlewood's three principles

Unit 3 Riemann integral (10hrs)

- Riemann integral
- The Lebesgue integral of a bounded function over a set of finite measure
- The integral of a nonnegative function
- The general Lebesgue integral
- Convergence in measure

Unit 4 Differentiation of monotone functions (9hrs)

- Differentiation of monotone functions
- Functions of bounded variation
- Differentiation of an integral
- Absolute continuity

Unit 5 L^p spaces (9hrs)

- L^p spaces
- The Holder's inequality
- The Minkowski's inequality
- Convergence and completeness

Reference Books:-

- 1) H. L. Royden, Real Analysis, Third Edition, PHI Learning Private Limited (2009) New Delhi.
- 2) N. L. Carothers, Real Analysis, Cambridge University Press (2000).
- 3) G de Barra, Measure Theory and Integration, Wiley Eastern Limited, First Wiley Eastern Reprint (1987).
- 4) V. Karunakaran, Real Analysis, Pearson (2012).
- 5) S. K. Berberian, Fundamentals of Real Analysis, Universitext, Springer (1999).
- 6) I. K. Rana, An introduction to Measure and Integration, Narosa Publishing House, New Delhi.

Semester – VIII			
16IMTCC40	Core 8: Theory of Partial Differential Equations	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Identify and understand the higher order partial differential equations.
2. Understand and utilize the methods to solve the given partial differential equations
3. Understand and solve the given Boundary value problems and Equipotential surfaces.

Unit 1 Second order partial differential equations (10hrs)

- Origin of second order partial differential equations
- Linear second order partial differential equations with constant coefficients
- Solutions for $f(x; y)$ to be polynomial
- Exponential, sin/cos functions
- General method for homogeneous equations

Unit 2 Classification of second ordered partial differential equations (10hrs)

- Classification of second ordered partial differential equations
- Canonical form

Unit 3 Non-linear second order partial differential equations (10hrs)

- Non-linear second order partial differential equations
- solution by Monge's method
- Special case and general case

Unit 4 Second order partial differential equations with variable coefficients (9hrs)

- Second order partial differential equations with variable coefficients
- Method of changing variables for special type of equations
- Separation of variable Method
- Solution of three special equations –Laplace
- Wave and diffusion equation
- Solution of these equations in different coordinate systems

Unit 5 Boundary value problems (9hrs)

- Boundary value problems
- Dirichlet boundary value problems
- Neumann boundary value problems
- Maximum and minimum principles
- Harnack's theorem
- Green's functions
- Equipotential surfaces

Reference Books:-

- 1) Amarnath, T., Elementary Course in Partial Differential Equations, Narosa Publ. House, New Delhi, 1997.
- 2) Sneddon, I. N., Elements of Partial Differential Equations, McGraw- Hill Publ. Co., 1957
- 3) Grewal, B. S. and Grewal, J. S., Higher Engineering Mathematics, (36th Edition), Khanna Publ. New Delhi, 2000.
- 4) Raisinghania, M. D. Advanced Differential Equations, S. Chand & Co., 1995.
- 5) Phoolan Prasad and Ravindran, R., Partial Differential Equations, Wiley Eastern.

Semester – VIII			
16IMTDC09	DSE Core - II Classical Mechanics - II	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand, define and verify Rigid Body Equations of Motion.
2. Understand and compare theory of relativity in classical mechanics.
3. Derive the Hamilton's equation of motion.
4. Understand and utilize the Canonical transformations and Generating functions.

Unit 1 The Rigid Body Equations of Motion (10hrs)

- Angular momentum and kinetic energy of motion about a point
- The inertia tensor and moment of inertia
- The heavy symmetrical top with one point fixed

Unit 2 Special Relativity in Classical Mechanics (10hrs)

- The basic program of special relativity
- The Lorentz transformations
- Lorentz transformations in real four dimensional spaces
- Further descriptions of the Lorentz transformation

Unit 3 Covariant four – dimensional formulations (10hrs)

- Covariant four – dimensional formulations
- The force and energy equations in relativistic mechanics

Unit 4 Hamilton's equation of Motion (9hrs)

- Derivation of Hamilton's equation of motion
- Routh's procedure
- Derivation of Hamilton's equation from Hamilton's Principle
- Principle of least action
- Problem related to above topics

Unit 5 Canonical transformations and Generating functions (9hrs)

- Poisson's brackets and their properties
- Hamilton-Jacobi theory
- Problem related to above topics

Reference Books:-

- 1) H. Goldstein, Classical Mechanics, 2nd Edition, Narosa Publishing House
- 2) C. R. Mondal, Classical Mechanics, Prentice Hall of India Pvt. Ltd.

Semester – VIII			
16IMTDC10	DSE Core – II: Mathematical Methods	4hrs/wk	4Credits

Objectives:

Upon completion of the course students will be able to

1. Understand, define and utilize Fourier series and Summation of infinite series.
2. Understand, define and utilize Laplace transform, Inverse Laplace transform, Convolution theorem, apply these concepts to solve the ordinary differential equations.
3. Understand and utilize Green's function and its applications, Gram-Schmidt orthonormalization method to Legendre polynomials, Hermite polynomials, Jacobi polynomials, Z-transform.

Unit 1 Fourier series and applications (10hrs)

- Fourier series and applications to boundary value problems
- Summation of infinite series.

Unit 2 Fourier integral representation and applications (10hrs)

- Fourier integral representation and applications
- Fourier transforms
- Computations of Fourier transforms of functions
- Properties of Fourier transforms

Unit 3 Convolution and Fourier transform (10hrs)

- Convolution and Fourier transform
- Applications to the boundary value problems involving Heat equation
- Wave equation and Laplace equations

Unit 4 Laplace transforms (9hrs)

- Laplace transform
- Laplace transforms of some functions
- Properties of Laplace transform
- Inverse transform
- Convolution theorem
- Applications to solutions of ordinary differential equations
- Applications to the solutions of diffusion equation and wave equation

Unit 5 Green's function and its applications (9hrs)

- Green's function and its applications
- Gram-Schmidt orthonormalization method to Legendre polynomials
- Hermite polynomials
- Jacobi polynomials
- Z-transform

Reference Books:-

- 1) Shankar Rao, Introduction to Partial Differential Equations.
Shree M. & N. Virani Science College, Rajkot. 5 Year Integrated B.Sc. - M.Sc. Mathematics

- 2) Courant and Hilbert; Mathematical Methods.
- 3) N. Sneddon; Special Functions of Mathematical Physics and Chemistry.
- 4) L.A. Pipes, Applied Mathematics for Engineers and Physicists.
- 5) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 2004
- 6) M. D. Raisinghania Advanced Differential Equations.