M. G. Science Institute, Ahmedabad

Autonomous | Affiliated to Gujarat University, Ahmedabad

(Managed by The Ahmedabad Education Society)

Department of Mathematics

Bachelor of Science (Hons.) in Mathematics

B.S. (Hons.) Mathematics

(Effective from Academic Year 2024-25)

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1. Preamble

B.Sc. (Hons.) with Mathematics is a 4-year undergraduate programme spread over eight semesters. Mathematics, as language, art, and science, plays a very vital role in shaping our understanding of the world. Our B.Sc. (Hons.) in Mathematics is designed to equip students with the theoretical foundations, practical skills, problem solving and critical thinking abilities necessary to navigate the ever-expanding landscape of problems inquiry. Guided by expert faculties, students will dig into a comprehensive curriculum that covers key areas such as Calculus, geometry, mathematical analysis, Graph theory, mathematical finance, computational techniques. Through a combination of coursework and practical's, students will develop proficiency in mathematical methods, various computational tools, and logical techniques essential for addressing real-world problems across diverse domains.

Upon completion of the B.Sc. (Hons.) program in Mathematics, graduates will emerge as versatile professionals equipped to tackle real-world problems in academia, industry, government, and beyond. Our alumni are poised to excel as research scientists, consultants, and decision-makers and make impactful contributions to the globe.

2. Definitions

2.1. Bachelor Degree

Bachelor's Degree is designed to offer the undergoing students a broad foundation necessary for a science-based career with a special focus on multidisciplinary learning.

2.2. Bachelor Degree (Hons.)

Bachelor's Degree (Hons.) aims at providing advanced and specialized theoretical and research skills in the chosen science subject, along with the overall knowledge in the sciences, to provide the students a strong platform for an advanced academic or professional career.

2.3. Choice Based Credit System

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising Core, minor, multi-disciplinary, or skill-based courses.

2.4. Credit

Credits means the value assigned to a course which indicates the level of instruction:
1 hour lecture per week equals 1 credit
2 hours practical per week equals 1 credit
Credit for a practical could be proposed as part of a course or as a separate practical course.

2.5. SGPA

SGPA means Semester Grade Point Average calculated for individual semesters.

2.6. CGPA

CGPA means Cumulative Grade Point Average calculated for all courses completed by the students at any point of time. CGPA is calculated for each year for both semesters clubbed together.

2.7. Course

A course is a specific subject in the academic programme taught in a particular semester for the specifically assigned number of credits.

2.8. Course Announcement

The college shall announce the elective courses it proposes to offer to the students out of the wider course basket. It is not mandatory to offer all the electives. The decision of the principal shall be final in this case. However, in the spirit of Choice Based Credit System, the college should offer choices to the students for the elective courses and not offer only the minimum number of electives.

2.9. Course Registration

It is mandatory for every student, to register every semester, for the elective courses opted for that semester. Each student, on admission, shall be assigned to a Faculty Advisor who shall advise him/her about the academic programs and counsel on the choice of courses considering the student's profile, career goals, and courses taken in the earlier semesters. With the advice and consent of the Faculty Advisor, the student shall register for a set of courses he/she plans to take up for the Semester. Students shall have to register for the courses for the semester within the first week of Semester I and immediately after the conclusion of the preceding term for subsequent Semesters II, III, IV, V, VI, VII, and VIII.

2.10. Course Outcomes

Course outcomes are the specific and measurable attributes defining the knowledge, skill and attitude of the learners are expected to demonstrate by the completion of the course.

2.11. Grading System

The Grading System is the 10-point standard scale system defined by the UGC comprising of the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

2.12. Graduate Attributes

The Graduate Attributes are the generic abilities, attitudes and approaches expected to be demonstrated by the learner in the world around him/her in a longer period of the lifetime.

2.13. Learning Outcomes

Learning outcomes describe the measurable skills, abilities, knowledge, or values that students should be able to demonstrate as a result of completing a course.

2.14. Outcome Based Education (OBE) Approach

OBE is the approach focusing on the performance outcome comprising of the following:

a. The performer – the student (learner), not only the teacher.

b. The performable (thus demonstrable or assessable) to perform
c. The performance outcome, not the activity or task to be performed.

2.15. Outcome-Based Assessment

An assessment system that asks course teachers to first identify what it is that we expect students to be able to do once they have completed a course or program. It then asks course teachers to provide evidence that they are able to do so. In other words, how will each learning outcome be assessed? What **evidence of student learning** is most **relevant for each learning outcome** and **what standard or criteria** will be used to evaluate that evidence? Assessment is therefore a key part of outcome-based education and used to determine whether or not a qualification has been achieved.

2.16. Programme Educational Objectives

Programme Educational Objectives are a set of **broad future-focused student performance outcomes** that explicitly identify what students will be **able to do with what they have learned**, and what **they will be like** after they leave school and are **living full and productive lives**. Thus, PEOs are what the programme is preparing graduates for in their **career and professional life** (to attain within a **few years** after graduation).

2.17. Programme Outcomes

Programme Outcomes are a set of **narrow statements** that describe what learners of the programme are expected to know and be able to perform or attain by the time of graduation.

2.18. Programme Specific Outcomes

The PSOs are a set of narrow statements that describe what the learners of a particular specialization of the programme are expected to know and be able to perform or attain by the time of graduation. PSOs are also a function of the various course combinations offered by the college.

2.19. Semester

The Semester means the one half of the academic year comprising of the teaching days and examination & evaluation days as per the UGC/ University norms.

2.20. Teaching and Learning Activities

The set of **pedagogical tools and techniques** or the teaching and learning activities that aim to **help students to attain** the intended learning outcomes and engage them in these learning activities through the teaching process.

3. B.Sc. Programme Focus

3.1 Programme Educational Objectives (PEOs)

PEO-1 **Core competency:** will develop the competency to pursue higher education or successful professional career with synergistic combination of the knowledge and skills of mathematics and allied sciences.

PEO-2 **Breadth of knowledge:** will show capabilities of independently designing, executing, and interpreting mathematical problems by integrating the interdisciplinary knowledge of Mathematics and other domains.

PEO-3 **Preparedness:** will reflect professional behaviors and have the potential to show preparedness to take any task or assignment in the capacity of a

leader or team member in their chosen occupations or careers and communities.

PEO-4 **Professionalism:** will reflect values and responsibilities in the character to make them fit to work in a multidisciplinary team and to become socio-ethically responsible citizen.

PEO-5 **Learning environment:** will show attitude of self-learning abilities and keep themselves abreast with new development in all spheres of life.

3.2 Programme outcomes (POs)

PO 1 **Professionalism and Ethics:** Exhibit responsibility and professionalism that is based on ethical, selfless, moral, and compassionate principles.

PO 2 **Leadership and Social Acuity:** Capable of taking responsibility as a leader and demonstrating responsiveness to the regional and national environments developing abilities to manage challenges for nation-building.

PO 3 **Digital Competence:** Able to use technology and skills to process information and data for the benefit of society.

PO 4 **Communication and Teamwork:** Interact effectively with stakeholders, fostering an environment of teamwork, mutual respect, and shared decision-making skills.

PO 5 **Critical Thinking:** Foster a curious mindset, analyze and develop critical thinking skills, and become active learners.

3.3 Programme Specific Outcomes (PSOs)

PSO 1 Understand the advanced concepts of mathematics and demonstrate the ability to apply the knowledge of mathematics at an advanced level.

PSO 2 Collect, organize, and adapt contemporary knowledge effectively and utilize appropriate computational tools independently and analyze and perform a broad variety of mathematical experiments using mathematical software and internet.

PSO 3 Develop and apply new theories of mathematics to solve a broad variety of problems involving mathematics.

PSO 4 Apply critical thinking skills for sustainable development and develop the knowledge and skills to secure employment.

PSO 5 Exhibit the capacity to identify, formulate, and solve problems pertaining to mathematics through research and critically evaluate the theoretical results and recognize the need for, and an ability to engage in life−long learning

PSO 6 provides a platform for pursuing higher studies leading to a postgraduate or doctorate.

3.4 Graduate Attributes (GAs)

These attributes reflect the core competencies necessary for graduates to succeed in the field. The common graduate attributes for B.Sc. Mathematics are:

a) Ability to analyze complex real-world data sets and extract meaningful insight. Proficiency in statistical analysis and data interpretation.

b) Apply mathematical and statistical concepts, including linear algebra, calculus, basic Mathematics, probability, and statistical inference to Data Science and Machine Learning problems.

c) Demonstrate proficiency in statistical concepts used in data analysis with the help of statistical software like MS Excel, C programming, and R Programming.

d) Understanding of data collection, storage, retrieval, and management techniques. Familiarity with databases and data warehousing.
e) Ability to apply statistical methods to solve real-world problems.
f) Effective communication and collaboration with colleagues from diverse backgrounds.

4. B.Sc. Programme Course Types and Evaluation Pattern

Sr. No.	Course Type	Credits	Nature	CCE Marks	ECE Marks	Total Marks
1	Major Course	4	Compulsory	50	50	100
2	Minor Course	4	Compulsory	50	50	100
3	Multidisciplinary Course	4	Elective	50	50	100
4	Skill Enhancement Course	2	Elective	25	25	50
5	Ability Enhancement Course	2	Elective	25	25	50
6	Indian Knowledge System/ Value Added Courses	2	Elective	25	25	50

4.1. Course Types Definitions:

1. **Major Course (DSC-C)**
   Discipline-specific course core is a course that a student admitted to a particular programme must successfully complete receiving the degree and which cannot be substituted by any other course.
2. **Minor Course (DSC-M)**
   A discipline Specific Minor Course refers to a set of academic courses that form a focused and specialized area of study within a particular discipline. Students have the option to pursue a minor alongside their major allowing them to gain additional expertise in a specific subject.
3. **Multidisciplinary Course (IDC)**
   A multidisciplinary course is a course chosen generally from a related discipline/subject, intending to seek exposure in the discipline relating to the core domain of the student.
4. **Skill Enhancement Course (SEC)**
   Skill Enhancement Course is designed to provide students with specific skills or knowledge in addition to their primary academic pursuits. The main purpose of the SEC is to provide students with practical skills, life skills, soft skills, hands-on training, etc. to increase their employability.
5. **Ability Enhancement Course (AEC)**
   The ability enhancement course is designed to improve students' communication, language, and personality development skills. The main purpose of the AEC is to introduce students to the theory, fundamentals, and tools of communication and to develop in them vital communication skills that should be integral to personal, social, and professional interactions.
6. **Indian Knowledge System (IKS)**

Indian Knowledge System refers to the rich and diverse heritage of knowledge, wisdom, and traditions that have evolved over millennia within the Indian subcontinent.

7. **Value-aided Course (VAC)**
   Value-aided courses refer to those courses designed to enhance the standard of the students beyond those levels specified in the academic curriculum.

5. B.Sc. Programme Structure

B.Sc. (Hons.) Mathematics is a four-year programme divided into eight semesters. A student is required to complete 176 credits for the completion of the programme and the award of B.Sc. (Hons.) Mathematics degree.

The B.Sc. (Hons.) Mathematics programme is aligned with the NEP-2020 structure as given in below Table.

Courses	No. of Papers	Credits Each	Total Credits
1. DSC-Major	22	4	88
2. DSC-Minor	8	4	32
3. IDC-Multi	3	4	12
4. AEC	5	2	10
5. SEC Internship	5 1	2 4	10 4
6. IKS/VAC OJT/RP	4 2	2 6	8 12
		Total	**176**

Details of Programme

Year	Semester	Course Type (Credits)						
1st Year	Sem-I	Major-1 (T-4C)	Major-2 (P-4C)	Minor-1 (T-2C+P-2C)	MDC-1 (T-2C+P-2C)	AEC-1 (2)	SEC-1 (2)	IKS-1 (2)
	Sem-II	Major-3 (T-4C)	Major-4 (P-4C)	Minor-2 (T-2C+P-2C)	MDC-2 (T-2C+P-2C)	AEC-2 (2)	SEC-2 (2)	VAC-1 (2)
2nd Year	Sem-III	Major-5 (T-4C)	Major-6 (T-4C)	Major-7 (P-4C)	MDC-3 (T-2C+P-2C)	AEC-3 (2)	SEC-3 (2)	IKS-2 (2)
	Sem-IV	Major-8 (T-4C)	Major-9 (T-4C)	Major-10 (P-4C)	Minor-3 (T-2C+P-2C)	AEC-4 (2)	SEC-4 (2)	VAC-2 (2)
3rd Year	Sem-V	Major-11 (T-4C)	Major-12 (T-4C)	Major-13 (P-4C)	Minor-4 (T-4C)	Minor-5 (P-4C)	SEC-5 (2)	-
	Sem-VI	Major-14 (T-4C)	Major-15 (T-4C)	Major-16 (P-4C)	Minor-6 (T-2C+P-2C)	AEC-5 (2)	Internship (4)	-
4th Year	Sem-VII	Major-17 (T-4C)	Major-18 (T-4C)	Major-19 (P-4C)	Minor-7 (T-2C+P-2C)	-	OJT/RP-1 (6)	-
	Sem-VIII	Major-20 (T-4C)	Major-21 (T-4C)	Major-22 (P-4C)	Minor-8 (T-2C+P-2C)	-	OJT/RP-2 (6)	-

(T-xC =Theory- x credits , P-xC =Practical -x Credits)

6. Multiple Entry-Exit Option

The B.Sc. programme is fully compliant with the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC. Accordingly, the programme provides the exit option to the learners at the end of the first year with **UG Certificate** awarded, at the end of the second year with **UG Diploma** awarded, at the end of the third year with **UG Degree** awarded and at the end of the fourth year with **UG Honors Degree** awarded. The learners choosing to exit the programme at the end of the first year or at the end of the second year will be allowed to, subject to successful completion of the relevant portion of the curriculum, shall be allowed to re-enter within a period of three years and complete the degree programme within a period of maximum seven years from the year of the first admission. All the other details are as provided in Sec.3.2.3 of the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC in December 2022.

7. Internship Project

Every learner must undergo and complete the internships/apprenticeships in a firm/ industry/organization or training in labs with faculty or researchers in their own or other college/institute/research institution during the summer term. Completion of the Summer Internship shall be mandatory for every learner choosing to exit at the end of the first year with a UG Certificate or at the end of the second year with a UG Diploma. The Internship Project shall carry the weightage of 4 credits. Since the internship is categorized as Practice, every learner will have to actually produce the work for 120 hours during the internship.

Evaluation of the Internship Project:

It is mandatory for the student to seek advance written approval from the faculty guide and the HOD for the internship and organization before commencing the internship.

a. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.
b. Students shall also seek a formal evaluation of their Internship Project from the external guide. The formal evaluation by the external guide shall be done for 50 marks and comment on the nature and quantum of work undertaken by the student, the effectiveness and overall professionalism. The learning outcomes of the Internship Project and utility of the project to the host organization must be specifically highlighted in the formal evaluation by the external guide. The Internship Project

evaluation sheet duly signed and stamped by the external guide shall be included in the final Internship report.

c. The completion of the SIP shall be certified by the respective Faculty Guide & approved by the Director of the Institute.
d. The college level evaluation shall be for 50 marks through the Viva-Voce conducted by the faculty guide and HOD of the respective department.
e. Copies of SIP report and records of evaluation shall be maintained by the college for a period of 5 academic years.

8. Comprehensive Internal Evaluation (CIE)/Comprehensive Concurrent Evaluation (CCE)

1. The course teacher shall prepare the scheme of Comprehensive Concurrent Evaluation (Formative Assessment) before commencement of the term. The scheme of Comprehensive Concurrent Evaluation shall explicitly state the linkages of each CCE with the Course Outcomes and define the targeted attainment levels for each CO.
2. The Head of the Department shall approve the scheme of Comprehensive Concurrent Evaluation with or without modifications.
3. The course teacher shall display, on the notice board/ ERP, the approved CCE scheme of the course and the same shall also be hosted on the website, not later than the first week of the term.
4. Each CCE item shall be of minimum 25 marks.
5. For a 4 Credit Course there shall be a MINIMUM of three CCE items. The final scores shall be converted to 50, using an average or best two out of three formulae.
6. For 2 Credit Course there shall be a MINIMUM of two CCE items. The final scores shall be converted to 50.
7. CCE shall be spread through the duration of course and shall be conceptualized, executed, assessed and documented by the course teacher along with student-wise and class-wise attainment levels of the COs and the attainment levels of the course.
8. The assessment outcome of each CCE shall be duly signed by the course teacher & the programme coordinator / HOD of the college.
9. A copy of the duly signed CCE outcome shall be displayed on the notice boards/ ERP, within a week of the assessment and course teachers shall guide the students on a need basis.
10. The college may conduct additional make up / remedial CCE items at its discretion.
11. At the end of the term aggregate CCE scores/grades shall be calculated and the CO attainment levels shall be calculated by the course teacher. The same shall be displayed on the notice board/ ERP.
12. Records of CCE shall be retained for 5 years from the completion of the Academic Year. i.e. Current Academic Year (CAY) + 4 years.

The comprehensive internal evaluation shall be conducted by the college once a semester. The maximum marks for 4 credit courses shall be 50 and for 2 credit courses shall be 25 marks.

9. End-Semester Evaluation

1. The End Semester Evaluation (Summative Evaluation) for all the courses shall be conducted by the Examination Department/Committee of the college headed by a full-time regular faculty member nominated by the Principal as Controller of the Examination.
2. The ESE for each course shall have the weightage as follows:
    - For a 4 Credit Course: 50 marks

- For a 2 Credit Course: 25 marks

3. The ESE for each course shall have 5 questions each of 10 marks. In case of 2 Credit courses the aggregate marks out of 50 shall be converted to the level proportionate to 25 marks.
4. All questions shall be compulsory with internal choice within the questions.
5. The broad structure of the ESE question paper shall be as follows:

Question Number	COGNITIVE ABILITIES EVALUATED	Nature
Q.1	REMEMBERING	Answerany5outof8(2markseach)
Q.2	UNDERSTANDING	Answerany2outof3(5markseach)
Q.3	APPLYING	Answer3(a)or3(b)(10marks)
Q.4	ANALYSING	Answer4(a)or4(b)(10marks)
Q.5	EVALUATING	Answer5(a)or5(b)(10marks)
	CREATING	

10.Passing Standard

A learner shall be said to have earned the credits for a course if he/she earns minimum 36% marks.

Formative Evaluation and Summative Evaluation shall be separate head of passing.

10.1. Grading System

The Indirect and Absolute Grading System shall be used, i.e. the assessment of individual Courses in the concerned examinations will be on the basis of marks. However, the marks shall later be converted into Grades by a defined mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. The overall evaluation shall be designated in terms of Grade. The 10-point standard scale mandated by UGC shall be used.

The performance of a student will be evaluated in terms of two indices, viz.

(a) Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester

(b) Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Grade Point (Gi) (10 points scale) = Marks of each paper out of 100 / 10

Marks out of 100	Grade Point Range (Gi)	Letter Grade	Classification
96.0-100	10	O	Outstanding
86.0-95.9	9	A+	Excellent
76.0-85.9	8	A	Very Good
66.0-75.9	7	B+	Good
56.0-65.9	6	B	Above Average
46.0-55.9	5	C	Average
36.0-45.9	4	P	Pass
Below 36.0	0	F	Fail
Absent	0	Ab	Absent

The Semester Grade Point Average (SGPA) is the ratio of the sum of the product of the number of credits with the grade point scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA\ (Si) = \Sigma\ (Ci \times Gi) / \Sigma\ Ci$$

where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

The cumulative grade point average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.,

$$CGPA = \Sigma\ (Ci \times Si) / \Sigma\ Ci$$

where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that i^{th} semester.

The SGPA and CGPA shall be rounded off to 2 decimal points.

10.2. Scaling Down of the CIE Score

The marks obtained by the student for the CCE shall be scaled down, to the required extent, if the percentage of the marks of CCE exceeds the percentage of marks scored in the ESE (End Semester University Examination) by 25% for the respective course.

10.3. Degree Requirements

The degree requirements for the B.Sc. DSA programme are the completion of a minimum 136 credits and 180 credits in case of an Honours degree.

10.4. Maximum Duration for Completion of the Programme

The program of the study is four years of eight semesters. A candidate shall complete his/her degree within **seven (7)** academic years from the date of his/her admission to the first semester.

10.5. Grade Improvement

There shall be a provision for candidates to reappear for the examination for the concerned course of theory papers only (subject) in which the candidate wishes for improvement of his/ her grade point of SGPA in general and CGPA in a total of the program subject to the condition that:

a) The candidate shall be eligible to reappear for improvement of grade points only after successfully passing the program.

b) The candidate may opt for the examination for any number of courses (subject/paper)of the programme for improvement of grade points but not more than three times for eachcourse (subject/paper) as per the prevailing syllabus of the examination conducted inthe regular schedule of University examinations.
c) All such provisions are there within 04 years from successful completion of theprogramme, but not exceeding the period of 08 years of the duration of completion of the programme.
d) In all such cases grade points are considered if there is a progress in such improvements,otherwise, original grade points shall be retained.
e) No such candidates shall be eligible for the award of Rank, Gold Medal, Cash Prize, etc.
f) The validity of credits earned will be for a maximum period of seven years or as specified by the Academic Bank of Credits (ABC).

11.Attendance

The student must meet the requirement of 75% attendance per semester per course for grant of the term. The college may condone the shortage in attendance in exceptional circumstances, up to a maximum of 10%. The college shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

12.Medium of Instruction

The medium of instruction and evaluation shall be English.

13.Detailed Course List (Annexure-1)

Detailed course list is available in Annexure-1

14.Detailed Syllabus for Each Course (Annexure-2)

Detailed syllabus for each course is available in Annexure-2

14.1. Annexure 1

Detailed Course List for B.Sc. (Hons.) Mathematics

Mathematics Major Courses
(Compulsory Course – 4 Credits Each)

Course No.	Course Code	Course Title	Semester	Hours/ Week
MAT-111	MAM111T	Calculus and Matrix Algebra	1	4
MAT-112	MAM112P	Mathematics Major Practical-112	1	8
MAT-121	MAM121T	Co-ordinate Geometry and Differential Equations	2	4
MAT-122	MAM122P	Mathematics Major Practical-122	2	8
MAT-231	MAM231T	Linear Algebra-I	3	4
MAT-232	MAM232T	Calculus-I	3	4
MAT-233	MAM233P	Mathematics Major Practical-233	3	8
MAT-241	MAM241T	Abstract Algebra-I	4	4
MAT-242	MAM242T	Calculus-II	4	4
MAT-243	MAM243P	Mathematics Major Practical-243	4	8
MAT-351	MAM351T	Complex Analysis I	5	4
MAT-352	MAM352T	Numerical Analysis	5	4
MAT-353	MAM353P	Mathematics Major Practical-353	5	8
MAT-361	MAM361T	Real Analysis-I	6	4
MAT-362	MAM362T	Partial Differential Equations.	6	4
MAT-363	MAM363P	Mathematics Major Practical-363	6	8
MAT-471	MAM471T	Topology-I	7	4
MAT-472	MAM472T	Real Analysis-II	7	4
MAT-473	MAM473P	Mathematics Major Practical-473	7	8
MAT-481	MAM481T	Functional Analysis-I	8	4
MAT-482	MAM482T	Linear Algebra-II	8	4
MAT-483	MAM483P	Mathematics Major Practical-483	8	8

Mathematics Minor Courses
(Compulsory Course)

Course No.	Course Code	Course Title	Semester	Credits	Hours/ Week
MAT-113(T)	MAE113T	Matrix And Calculus	1	2	2
MAT-113(P)	MAE113P	Mathematics Minor Practical-113	1	2	4
MAT-123(T)	MAE123T	Co-Ordinate Systems and Differential Equation	2	2	2
MAT-123(P)	MAE123P	Mathematics Minor Practical-123	2	2	4
MAT-244(T)	MAE244T	Discrete Mathematics	4	2	2
MAT-244(P)	MAE244P	Mathematics Minor Practical-244	4	2	4
MAT-354(T)	MAE354T	Graph Theory	5	4	4
MAT-355(P)	MAE355P	Mathematics Minor Practical-355	5	4	8
MAT-364(T)	MAE364T	Operations Research	6	2	2
MAT-364(P)	MAE364P	Mathematics Minor Practical-364	6	2	4
MAT-474(T)	MAE474T	Mathematical Modelling	7	2	2
MAT-474(P)	MAE474P	Mathematics Minor Practical-474	7	2	4
MAT-484(T)	MAE484T	Stochastic Processes	8	2	2
MAT-484(P)	MAE484P	Mathematics Minor Practical-484	8	2	4

Mathematics Multidisciplinary Courses
(Compulsory Course – 4 Credits Each)

Course No.	Course Code	Course Title	Semester	Credits	Hours/ week
MAT-114 (T)	MAMDC114T	Basics In Finance and Discrete Mathematics	1	2	2
MAT-114 (P)	MAMDC114P	Mathematics Multi Practical-114	1	2	4
MAT-124 (T)	MAMDC124T	Linear Algebra and Abstract Algebra	2	2	2
MAT-124 (P)	MAMDC124P	Mathematics Multi Practical-124	2	2	4
MAT-234 (T)	MAMDC234T	Numerical Analysis	4	2	2
MAT-234 (P)	MAMDC234P	Mathematics Multi Practical-234	4	2	4

Ability Enhancement Courses
(Elective Course – 2 Credits Each)

Course No.	Course Code	Course Title	Semester
AEC-115	AE - 01		1
AEC-125	AE - 02		2
AEC-235	AE - 03		3
AEC-245	AE - 04		4
AEC-365	AE - 05		6

Skill Enhancement Courses
(Elective Course – 2 Credits Each)

Course No.	Course Code	Course Title	Semester
SEC-116	MASEC116	Vedic Mathematics-I	1
SEC-126	MASEC126	Vedic Mathematics-II	2
SEC-236	MASEC236	Basic Excel-I	3
SEC-236	MASEC236	MATLAB-I	3
SEC-246	MASEC246	Basic Excel-II	4
SEC-246	MASEC246	MATLAB-II	4
SEC-356	MASEC356	Basic Python Programming-I	5

Indian Knowledge System
(Elective Course – 2 Credits Each)

Course No.	Course Code	Course Title	Semester
IKS-117	IKS - 01		1
IKS-127	IKS - 02		3

Value Added Courses
(Elective Course – 2 Credits Each)

Course No.	Course Code	Course Title	Semester
VAC-237	VA - 01		2
VAC-247	VA - 02		4

14.2. Annexure 2

Detailed Syllabus for Each Course B.Sc. (Hons.) Mathematics

Semester-1

MAM111T: Calculus and Matrix Algebra

Semester: I	Course Title: Calculus and Matrix Algebra	Credit: 4
Course No.: 111T	Major-1 (T)	Hours: 4/week

COs with cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Memorize the basics of various matrices of real and complex numbers.
CO2	UNDERSTANDING	Explain and discuss the basics of Eigenvalues and Eigenvectors and Application of Matrix in solving linear equations
CO3	APPLYING	Demonstrate the convergent and divergent series using different methods
CO4	ANALYSING	Calculate the limit of indeterminate forms
CO5	EVALUATING	Evaluate Taylor's and Maclaurin's series to find power series in one variable
CO6	CREATING	Define successive derivatives of nth order

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		
CO 6		2	1	1	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Different Matrices and Rank of Matrix.** Introduction to matrices, different types 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. Linear dependence and independence of row and column matrices. Row rank, column rank and rank of a matrix. Row Reduced Echelon (RRE) form of a matrix and matrix inversion using it.	15
II	**Cayley Hamilton Theorem.** Eigen values, Eigen vectors and the characteristic equation of a matrix. Cayley- Hamilton (CH) theorem and its use in finding inverse of a matrix. Application of matrices in solving a system of simultaneous linear equations. Cramer's rule. Theorems on consistency of a system of simultaneous linear equations.	15

III	**Successive derivatives and power series.** a) Successive Derivatives, standard results for n^{th} derivative, Leibniz's Theorem. b) Definition of limit of a sequence, Convergence and divergence of an infinite series, Alternating Series (**without proof**). Comparison test, Ratio test and Root test, Power series.	15
IV	**Mean value theorems and L'Hospital rule.** a) Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems, Increasing and decreasing functions, Taylor's, and Maclaurin's Theorems (**both without proof**). Using Taylor's and Maclaurin's Theorem find Maclaurin power series expansion of $\sin x$, $\cos x$, $\log(1+x)$, e^x, $(1+x)^n$ under proper restrictions (if any). b) Indeterminate forms: all forms of L'Hospital's Rules.	15

Suggested Reference Books:

1. Calculus and Analytic Geometry – G. B. Thomas and R. L. Finney. Pearson Education. Indian Reprint.
2. Calculus – James Stewart, Sixth edition,(E-Book).
3. Calculus – T. M. Apostol. VolumeI.
4. Differential Calculus – Shanti Narayan, P.K. Mittal, S. Chand andCo.
5. Differential Calculus – Harikishan, AtlanticPublishers.
6. Calculus – M.Spivak.
7. An Introduction to Linear Algebra – I. K. Rana, Ane Books Pvt.Ltd.
8. Linear Algebra Theory and Applications – Ward Cheney, David Kincaid. Jones and Bartlet India Pvt.Ltd.
9. Introduction to Linear Algebra – Serge Lang. Springer(India).
10. Matrix and Linear Algebra – K. B. Dutta, PrenticeHall.
11. A Textbook of Matrices – Shanti Narayan, P K Mittal, S. ChandGroup.
12. Introduction to Linear Algebra – V. Krishnamurthy, Affiliated East-west Press PvtLtd.

MAM112P: Mathematics Major Practical-112

Semester: I	Course Title: Mathematics Major Practical-112	Credit: 4
Course No.: 112P	Major-2	Hours: 8/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Memorize and apply reduction formulas
CO2	UNDERSTANDING	Discuss the concepts related to lines and planes in space to solve problems
CO3	APPLYING	solve systems of linear equations using different methods
CO4	ANALYSING	Examine how to derive row echelon form and reduced row echelon form
CO5	EVALUATING	Evaluate examples on successive differentiation

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		

(Manual/Computer)

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Examples based on Reduction formula-I	5
2.	Examples based on Reduction formula-II	5
3.	Examples based on Reduction formula-III	5
4.	Examples on Line in space	5
5.	Examples on Plane in space-I	5
6.	Examples on Plane in space-II	5
7.	Gauss elimination method.	5
8.	Gauss Jacobi iterative method.	5
9.	Gauss Seidel iterative method.	5
10.	Examples on row echelon form.	5
11.	Examples on reduced row echelon form.	5
12.	Examples on application of Leibnitz theorem.	5
13.	Examples on n^{th} derivative.	5
14.	Examples of convergence of infinite series.	5
15.	Examples on Taylor series.	5
16.	Examples on Maclaurin series.	5

17.	Examples of limit using L'Hospital rule.	5
18.	Examples on eigen value and eigenvector.	5
19.	verification of Cayley Hamilton Theorem.	5
20.	Examples on representing a square metric as a sum of Hermitian and skew Hermitian matrix.	5
21.	Examples based on Rolle's mean value theorem.	5
22.	Examples based on LMVT.	5
23.	Examples based on CMVT.	5
24.	Problems on different types of errors.	5

MAE113T-Matrix and Calculus

Semester: I	Course Title: Matrix and Calculus	Credit: 2
Course No.: 113T	Minor -1 (T)	Hours: 2/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Memorize the basics of various matrices of real and complex numbers
CO2	UNDERSTANDING	Familiarize with basics of Rank of matrix and Application of Matrix in solving linear equations
CO3	APPLYING	Employ Taylor's and McLaurin's series to find power series in one variable
CO4	ANALYSING	Define successive derivatives of nth order

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Different Matrices and Rank of Matrix.** Introduction to matrices, different types 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. Linear dependence and independence of row and column matrices. Row rank, column rank and rank of a matrix. Row Reduced Echelon (RRE) form of a matrix and matrix inversion using it.	15
II	**Successive derivatives and power series.** a) Successive Derivatives, standard results for n^{th}derivative, Leibniz's Theorem. b) Definition of limit of a sequence, Convergence and divergence of an infinite series, Alternating Series (**without proof**). Comparison test, Ratio test and Root test, Power series.	15

Suggested Reference Books:

1. Calculus and Analytic Geometry – G. B. Thomas and R. L. Finney. Pearson Education. Indian Reprint.
2. Calculus – James Stewart, Sixth edition,(E-Book).
3. Calculus – T. M. Apostol. VolumeI.
4. Differential Calculus – Shanti Narayan, P.K. Mittal, S. Chand andCo.
5. Differential Calculus – Harikishan, AtlanticPublishers.
6. Calculus – M.Spivak.

7. An Introduction to Linear Algebra – I. K. Rana, Ane Books Pvt.Ltd.
8. Linear Algebra Theory and Applications – Ward Cheney, David Kincaid. Jones and Bartlet India Pvt.Ltd.
9. Introduction to Linear Algebra – Serge Lang. Springer(India).
10. Matrix and Linear Algebra – K. B. Dutta, PrenticeHall.
11. A Textbook of Matrices – Shanti Narayan, P K Mittal, S. Chand Group.
12. Introduction to Linear Algebra – V. Krishnamurthy, Affiliated East-west Press Pvt Ltd.

MAE113P: Mathematics Minor Practical-113

Semester: I	Course Title: Mathematics Minor Practical-113	Credit: 2
Course No.: 113P	Minor-1(P)	Hours: 4/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Memorize concepts related to lines and planes in space to solve problems
CO2	UNDERSTANDING	Discuss the systems of linear equations using different methods
CO3	APPLYING	Demonstrate how to derive row echelon form and reduced row echelon form
CO4	ANALYSING	Solve Examples on successive differentiation

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Gauss elimination method.	5
2.	Examples on row echelon form.	5
3.	Examples on reduced row echelon form.	5
4.	Examples on application of Leibnitz theorem.	5
5.	Examples on n^{th} derivative.	5
6.	Examples of convergence of infinite series.	5
7.	Examples on Taylor series.	5
8.	Examples on Maclaurin series.	5
9.	Examples of limit using L'Hospital rule.	5
10.	verification of Cayley Hamilton Theorem.	5
11.	Examples on representing a square metric as a sum of Hermitian and skew Hermitian matrix.	5
12.	Examples based on Rolle's mean value theorem.	5

MAMDC114T: Basics in Finance and Discrete Mathematics

Semester: I	Course Title: Basics in Finance and Discrete Mathematics	Credit: 2
Course No.: 114T	MDC-1(T)	Hours: 2/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Describe the fundamental financial instruments and Identify arbitrage opportunities in financial markets
CO2	UNDERSTANDING	Discuss the returns and interest rates associated with financial cash flows. Apply the concept of time value of money, inflation and risk.
CO3	APPLYING	Choose methods such as Net Present Value (NPV) and Internal Rate of Return (IRR) to assess the profitability and feasibility of investment accurately.
CO4	ANALYSING	Analyze binary relations and their types, applying them in various mathematical contexts.
CO5	EVALUATING	Explain and interpret Hasse diagrams using POSET & LATTICE with their properties and applications.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Interest rates and NPV, IRR.** Basic Concepts: financial instruments, Arbitrage, Return and Interest, Time Value of Money, inflation, NPV and IRR.	15
II	**Relations and Hase Diaram** Binary Relation, Reflexive, Irreflexive, Symmetric, Antisymmetric, Transitive, Partial Ordering (omit lexicographic ordering), Hasse Diagram, Upper bound, lower bound, lub, glb, Lattice as a poset, Properties of lattices	15

Suggested Reference Books:

1. Hull, J. C. Options, Futures and Other Financial Derivatives, Prentice Hall, 8th edition.
2. Amber Habib, The Calculus of Finance, Universities Press.
3. Capinski, Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer
4. Boolean Algebra and its Application – J. E. Whitesitt, Addison-Wesley Publishing Co.Inc.
5. Foundation of Discrete Mathematics – K. D. Joshi, New Age International LimitedPublishers, ISBN 81-224-0120-1.
6. Logic and Boolean Algebra – B. H. Arnold, P H Inc LCCN62-19100.

MAMDC114P: Mathematics Multi Practical-114

Semester: I	Course Title: Mathematics multi practical 114	Credit: 2
Course No.: 114P	MDC-1(P)	Hours: 4/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Describe the returns, interest rates, future value and present value associated with financial cash flows.
CO2	UNDERSTANDING	Discuss Net Present Value (NPV) and Internal Rate of Return (IRR).
CO3	APPLYING	Use binary relations and apply them in various mathematical contexts.
CO4	ANALYSING	Examine and interpret Hasse diagrams using POSET.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Examples on finding present value and future value using simple interest rate add compounded interest rate also finding rate of return. (Manual/Excel/MATLAB)	5
2.	Examples on finding present value and future value using annual interest rate, which is compounded semi-annually, quarterly, monthly also finding effective interest rates. (Manual/Excel/MATLAB)	5
3.	Examples of finding present value and future value using annual interest rates which is compounded weekly, daily, and continuously compounded also finding effective interest rate. (Manual/Excel/MATLAB)	5
4.	Finding NPV of Given cash flow. (Manual/Excel/MATLAB)	5
5.	Bi-section method for finding the root of an equation. (Manual/Excel/MATLAB)	5
6.	Finding an IRR of given cash flow. (Manual/Excel/MATLAB)	5
7.	Examples based on binary relation and properties	5
8.	Examples based on types of relations.	5
9.	Examples on equivalence relation.	5
10.	Examples on PO set and Hase Diagrams.	5
11.	Examples on Boolean algebra.	5
12.	SOP and POS forms.	5

MSEC116-Vedic Mathematics-I

Semester: I	Course Title: Vedic Mathematics-I	Credit: 2
Course No.: 116	Skill Enhancement Course -1 (T & P)	Hours: 3/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
1	Remembering:	• Students will recall and apply various multiplication techniques, including Vedic Mathematics methods, for solving problems involving two and three-digit numbers. • They will remember and utilize squaring and cubing techniques, both traditional and shortcut methods, in practical scenarios.
2	Understanding:	• Learners will comprehend the concept of polynomials, their types, and degree, and recognize their significance in mathematical problem-solving. • They will understand the underlying principles of Vedic Mathematics techniques and apply them effectively in polynomial operations.
3	Applying:	• Students will demonstrate the application of polynomial concepts to real-world situations, such as finding HCF of polynomials and solving problems involving polynomial factors and common divisors. • They will apply Vedic Mathematics approaches to multiplication, squaring, cubing, and polynomial operations, enhancing both speed and accuracy in calculations.
4	Analysing:	• Learners will analyze complex mathematical problems involving multiplication, squaring, cubing, and polynomial operations, applying critical thinking skills to find solutions. • They will analyze polynomial equations, simplify expressions, and find solutions to real-world problems, demonstrating their problem-solving proficiency.
5	Creating:	• Students will develop mental arithmetic skills through timed drills, competitions, and practical exercises, fostering mathematical agility and the ability to solve problems efficiently. • They will create innovative solutions to mathematical problems by employing different strategies and techniques learned throughout the course.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		

Detailed syllabus:

Unit	Content (1 credit Theory)	No. of theory Hours
1	Multiplication Techniques - Introduction to Vedic Mathematics - Basic multiplication techniques: Vertical and crosswise, Ekadhikena Purvena - Multiplication of numbers with base method - Application of sutras in multiplication problems Squaring Numbers - Squaring two-digit and three-digit numbers - Vedic square roots method - Squaring numbers ending in 5 - Squaring numbers close to a base	5
2	Cubing Numbers - Cubing two-digit and three-digit numbers - General method for cubing numbers - Shortcut techniques for finding cube roots - Application of cubing techniques in problem-solving Introduction to Polynomials - Definition and types of polynomials - Polynomial operations: Addition, subtraction, multiplication, division - Degree of a polynomial and its significance	5
3	Highest Common Factor (HCF) of Polynomials - Understanding the concept of HCF - Finding HCF of two or more polynomials using Vedic Mathematics - Application of HCF in simplifying polynomials Multiplication of Polynomials - Vedic Mathematics techniques for polynomial multiplication - Multiplication of binomials, trinomials, and higher-order polynomials - Practice exercises to master polynomial multiplication Division of Polynomials - Division algorithm for polynomials - Long division method and its limitations - Vedic Mathematics approach to polynomial division - Solving division problems using Vedic sutras	5
Sr. No.	**Content (1 credit Practical)**	**No. of practical' s Hours**
1	**Practical Title 1: Multiplication Mastery** • Practice various multiplication techniques learned in Vedic Mathematics. • Solve a variety of multiplication problems involving two and three-digit numbers. • Engage in timed multiplication drills to improve speed and accuracy. • Work on real-life scenarios where rapid multiplication is essential.	5
2	**Practical Title 2: Squaring and Cubing Challenge** • Focus on mastering the techniques for squaring and cubing numbers. • Solve square and cube problems of varying complexities.	5

	• Conduct competitions and group activities to enhance skills in mental arithmetic. • Explore applications of squared and cubed numbers in mathematical puzzles and problems.	
3	**Practical Title 3: Polynomial Operations Workshop** • Practice addition, subtraction, multiplication, and division of polynomials. • Work on polynomial operations through interactive exercises and tasks. • Solve polynomial equations and simplify expressions using Vedic Mathematics techniques. • Collaborate with peers to solve challenging polynomial problems.	5
4	**Practical Title 4: HCF Exploration** • Investigate the concept of Highest Common Factor (HCF) in polynomials. • Apply Vedic Mathematics methods to find the HCF of polynomial expressions. • Solve problems involving polynomial factors and common divisors. • Work on real-world scenarios where understanding HCF is crucial, such as simplifying fractions.	5
5	**Practical Title 5: Polynomial Multiplication Marathon** • Engage in intensive practice sessions on multiplying polynomials. • Solve a variety of polynomial multiplication problems, including binomials, trinomials, and higher-order polynomials. • Participate in timed challenges to enhance speed and accuracy in polynomial multiplication. • Collaborate with peers to explore different strategies for efficient polynomial multiplication.	5
6	**Practical Title 6: Division of Polynomials Challenge** • Dive deep into polynomial division using Vedic Mathematics techniques. • Solve polynomial division problems through guided exercises and practice. • Explore long division and Vedic Mathematics approaches to divide polynomials. • Work on challenging division problems and real-life applications to reinforce learning.	5

Suggested Reference books.

1. Advanced Vedic Mathematics Rajeshkumar thakur, Rupa publications pvt. Ltd. 2019
2. Tirtha, Bharati Krishna. Vedic Mathematics. Publisher: Motilal Banarsidass, Year of Publication: 1965.
3. Williams, Kenneth. The Cosmic Calculator: Vedic Mathematics. Publisher: CreateSpace Independent Publishing Platform, Year of Publication: 2014.
4. Handley, Bill. Speed Mathematics Using the Vedic System. Publisher: John Wiley & Sons, Year of Publication: 2003.
5. Bathia, Dhaval. Vedic Mathematics Made Easy. Publisher: Jaico Publishing House, Year of Publication: 2006.

Semester-2

MAM121T: Co-ordinate Geometry and Differential Equations

Semester: II	Course Title: Co-ordinate Geometry and Differential Equations	Credit: 4
Course No.: 121T	Major-3 (T)	Hours: 4/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Describe various coordinate system in R^2 and R^3
CO2	UNDERSTANDING	Discuss geometrical concepts of various well-known surfaces.
CO3	APPLYING	Demonstrate to formulate and solve differential equations.
CO4	ANALYSING	Question on initial and boundary value problems.
CO5	EVALUATING	Evaluate first and higher order of differential equations

CO-PO-Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**various coordinate system in R^2 and R^3 and Cone and cylinder in R^3:** **(a)** Polar coordinates in R^2& R^3 and its Relationships with Cartesian coordinates, polar equation of line-/circle /conic and properties of conics. Mutual relationship between Spherical, Cylindrical and Cartesian coordinates. **(b)** Introduction to different types of cone and cylinder, Equations of enveloping cone and cylinder. Right circular cone/cylinder. Problems on cone and cylinder.	15
II	**Sphere and Introduction to conicoid:** **(a)** Definition of a sphere in R^3, Cartesian equation of a sphere, General equation of a sphere, Equation of a sphere with diametrically opposite end points, Intersection of a sphere with Line/plane/sphere(problems), Equation of a tangent plane to a sphere. The tangency of a plane and normality of a line to a sphere, Orthogonal spheres. **(b)** Conicoids: Introduction to conicoid, types of central and non-central conicoid in R^3, figures of conicoid	15

III	**Methods of solving Differential Equations of first order and first degree:** Variable separable, Homogeneous, and non-homogeneous differential equations, Exact differential equations **(without proof)**, Integrating factors, Linear differential equation of first order and first degree, Bernoulli's differential equation & Differential Equations reducible to them.	15
IV	**Method of solving differential equations of first order and higher degree:** Differential equations solvable for *y*, solvable for *x*, solvable for *p* (where$p = dy / dx$), Clairaut's differential equation (both general and singular), Lagrange's differential equation.	15

Suggested Reference Books:

1. Calculus - JAMES STEWART , THOMSONBROOKS/COLE
2. Calculus -T.M.Apostol
3. Calculus - Thomas and Finney , Pearson Education , Asianedition
4. Calculus - Dr. Elliot Mendel son, Mc GrawHill Bookco.
5. A first course in calculus fifth edition By Serge Lang , SpringerIndia
6. Ordinary and Partial Differential Equations Theory and Applications,By:Nita H. Shah,PHI
7. Introductory course in Differentialequations-Murray
8. Differential equations and their applications, Prentice Hall of India- Zafar Ahsan(1999)
9. Elementary Differential equations–Kella
10. Co-ordinate Geometry By : R.J.T.Bell
11. Solid Geometry(three dimension) – H. K. Das ,S. C. Saxena and Raisinghania , S.Chand

MAM122P: Mathematics Major Practical-122

Semester: II	Course Title: Mathematics major practical 122	Credit: 4
Course No.: 122P	Major-4(P)	Hours: 8/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Memorize solving differential equations.
CO2	UNDERSTANDING	Discuss and analyse the graphical behaviour of trigonometric functions and inverse trigonometric functions.
CO3	APPLYING	Solve an equation of cone, cylinder, and spheres from given properties.
CO4	ANALYSING	Questions on length of arc and curve using definite integrals.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Solving Differential equations Type-1 (C.F. has Real and distinct root)	5
2.	Solving Differential equations Type-2 (C.F. has Real and repeated root)	5
3.	Solving Differential equations Type-3 (C.F. has complex and distinct root)	5
4.	Solving Differential equations Type-4 (C.F. has complex and repeated root)	5
5.	Solving Differential equations Type-5 (P.I. has trigonometric function)	5
6.	Solving Differential equations Type-6 (P.I. has Polynomial function)	5
7.	Solving Differential equations Type-7 (P.I. has exponential function)	5
8.	Solving Differential equations Type-8 (P.I. has trigonometric function)	5
9.	Solving Differential equations Type-9 (P.I. has trig. + poly. function)	5
10.	Solving Differential equations Type-10(P.I. has exp.+trig. , exp + poly. function)	5
11.	Solving cubic polynomial equations Type-1 (using relations between root and co-efficient)	5
12.	Solving cubic polynomial equations Type-2 (Cardano method)	5
13	Problems on Sphere Type-1	5

14	Problems on Sphere Type-2	5
15	Graphs of Cartesian curves (Sinx, cosx, tanx, cosecx, secx, cotx).	5
16	Graphs of Cartesian curves (logarithm function, exponential function, sinhx, coshx, tanhx).	5
17	Graphs of Cartesian curves (circle, parabola, ellipse, hyperbola, asteroid)	5
18	Graphical method to find a real root of an equation.	5
19	The mutual relation between polar and Cartesian co-ordinate system in R^2. Transformation of points and equations from one system to another system.	5
20	The mutual relation among Cartesian, cylindrical and spherical co-ordinate system in R^3. Transformation of points and equations from one system to another system.	5
21	Problems on Cone.	5
22	Problems on Cylinder.	5
23	Find the length of arc and curves in Cartesian forms using definite integral.	5
24	Find the length of arc and curves in parametric forms using definite integral.	5

MAE123T Co-ordinate systems and Differential equation

Semester: II	Course Title: Co-ordinate systems and Differential equation	Credit: 2
Course No.: 123T	Minor-2(T)	Hours: 2/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEBERING	Describe various coordinate system in R^2 and R^3
CO2	UNDERSTANDING	Discuss how to formulate and solve differential equations.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2			
CO 2	1	1			

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**various coordinate system in R^2 and R^3 and Cone and cylinder in R^3:** **(a)** Polar coordinates in R^2& R^3 and its Relationships with Cartesian coordinates, polar equation of line-/circle /conic and properties of conics. Mutual relationship between Spherical, Cylindrical and Cartesian coordinates. **(b)** Introduction to different types of cone and cylinder, Equations of enveloping cone and cylinder. Right circular cone/cylinder (without proof). Problems on cone and cylinder.	15
II	**Methods of solving Differential Equations of first order and first degree:** Variable separable, Homogeneous, and non-homogeneous differential equations, Exact differential equations **(without proof)**, Integrating factors, Linear differential equation of first order and first degree, Bernoulli's differential equation & Differential Equations reducible to them	15

Suggested Reference books:

1. Discrete Mathematical Structures with Applications to Computer Science -J. R. Tremblay and R. Manohar, McGraw-Hill International Editions, ISBN 0-07-065142-6.e
2. Boolean Algebra and its Application – J. E. Whitesitt, Addison-Wesley Publishing Co. Inc.
3. Foundation of Discrete Mathematics – K. D. Joshi, New Age International Limited Publishers, ISBN 81-224-0120-1.
4. Logic and Boolean Algebra – B. H. Arnold, P H Inc LCCN 62-19100.
5. Introduction to Lattice Theory – D. E. Rutherford, University Mathematical Oliver and Boyed Ltd.
6. Modern Applied Algebra - Garret Birkhoff and Thomas C Bartee, CBS Publishers and Distributors.
7. Sets Lattices and Boolean Algebras - James C Abbott.

MAE123P: Mathematics Minor Practical-123

Semester: II	Course Title: Mathematics Minor practical 123	Credit: 2
Course No.: 123P	Minor-2 (P)	Hours: 4/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEBERING	Recall the method of solution of differential equations.
CO2	UNDERSTANDING	Discuss the skills in analysing the graphical behaviour of trigonometric functions and inverse trigonometric functions.
CO3	APPLY	Demonstrate an equation of cone, cylinder, and spheres from given properties.
CO4	ANALYZE	Calculate length of arc and curve using definite integrals.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Solving Differential equations Type-1 (C.F. has Real and distinct root)	5
2.	Solving Differential equations Type-2 (C.F. has Real and repeated root)	5
3.	Solving Differential equations Type-3 (C.F. has complex and distinct root)	5
4.	Solving Differential equations Type-4 (C.F. has complex and repeated root)	5
5.	Solving Differential equations Type-5 (P.I. has trigonometric function)	5
6.	Solving Differential equations Type-6 (P.I. has Polynomial function)	5
7.	Solving Differential equations Type-7 (P.I. has exponential function)	5
8.	Graphs of Cartesian curves (Sinx, cosx, tanx, cosecx, secx, cotx).	5
9.	Graphs of Cartesian curves (logarithm function, exponential function, sinhx, coshx, tanhx).	5
10.	Graphical method to find a real root of an equation.	5
11.	The mutual relation between polar and Cartesian co-ordinate system in R^2. Transformation of points and equations from one system to another system.	5
12.	The mutual relation among Cartesian, cylindrical and spherical co-ordinate system in R^3. Transformation of points and equations from one system to another system.	5

MAMDC124T: Linear Algebra and Abstract Algebra

Semester: II	Course Title: Linear Algebra and Abstract Algebra 124	Credit: 2
Course No.: 124T	MDC-2 (T)	Hours: 2/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEMBERING	Memorize the vector space and its properties.
CO2	UNDERSTANDING	Discuss linear dependence and linear independence with its properties.
CO3	APPLYING	Apply the fundamental concepts of groups and their elementary properties.
CO4	ANALYSING	Analyse and Identify subgroups, normalizers, and centralizers within groups.
CO5	EVALUATING	Explain principles of Lagrange's Theorem to analyse the order of groups and elements effectively.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Introduction to Linear Algebra.** Vector space: Definition, Examples, Properties, Subspaces, Necessary and Sufficient Condition to be a Subspace, Span of a Set, Examples of Subspaces, Intersection, Addition and Direct Sum of Subspaces., Linear Variety. Finite Linear Combination, Linear Dependence/Independence and their properties (with proof), Examples regarding Linear Dependence/ Independence. Dimension and Basis of a vector space, Dimension Theorem.	15
II	**Introduction to Abstract Algebra.** Definition and Examples of Groups, Elementary properties of Group, Equivalent Definitions of a Group, Finite Groups and their tables, Commutative and non-commutative groups. subgroups: Definition and Examples, normalizer and centralizers, order of an element, order of a group, cyclic subgroup generated by an element, Lattice diagrams of finite groups, cosets and its properties, Lagrange's Theorem.	15

Suggested Reference books

1. An Introduction to Linear Algebra – V. Krishnamurthy & others. (Affiliated East- West press, New Delhi)
2. Linear Algebra a Geometric Approach - S. Kumaresan, PHI.
3. Linear Algebra with Applications – Otto Bretscher– 3rd ed. –Pearson Education.
4. An Introduction to Linear Algebra – I. K. Rana ,Ane Books Pvt. Ltd., New Delhi.
5. Theory and Problems of Linear Algebra – R. D. Sharma, I K Int. Publishing House Pvt. Ltd.

6. Matrix and Linear Algebra – K. B. Datta, Prentice Hall, New Delhi.
7. Abstract Algebra - I. H. Sheth, PHI, New Delhi, Second edition-2009.
8. Topics in Algebra - I. N. Herstein, Vikas Publishing, New Delhi.
9. A First Course in Abstract Algebra – J. B. Fraleigh, Narosa Publishing, New Delhi.
10. Basic Abstract Algebra – P.B. Bhattacharya, S.K. Jain and S. R. Nagpal, Foundation Books, New Dehli.
11. Abstract Algebra - Dipak Chatterajee, PHI LearingPvt. Ltd, New Delhi.

MAMDC124P: Mathematics multi-Practical-124

Semester: II	Course Title: Mathematics multi practical 124	Credit: 2
Course No.: 124P	MDC-2 (P)	Hours: 4/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
CO1	REMEBERING	Recall the skills in solving problems related to vector spaces.
CO2	UNDERSTANDING	Discuss the properties of binary operations.
CO3	APPLYING	Demonstrate the Linear dependence and independence of vectors.
CO4	ANALYSING	Examine the concept of groups.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1		
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	1	2		

Sr. No.	Title of the Practical	No. of Hours of Teaching
1.	Examples on Vector space.	5
2.	Examples on Basis of V.S.	5
3.	Examples on Subspaces	5
4.	Examples on dimension	5
5.	Examples on L. I. Set-I	5
6.	Examples on L. I. set-II	5
7.	Examples on Binary operations I	5
8.	Examples on Binary operations II	5
9.	Examples on Group.	5
10.	Examples on Cyclic Group.	5
11.	Examples on Sub-Group.	5
12.	Examples on Lattice Diagrams.	5

MSEC116-Vedic Mathematics-II

Semester: II	Course Title: Vedic Mathematics-II	Credit: 2
Course No.: 126	Skill Enhancement Course -2 (T & P)	Hours: 3/week

COs with Cognitive Abilities

COs	COGNITIVE ABILITIES	COURSE OUTCOMES
1	**Knowledge and understanding**	• Understand the fundamental concepts and historical development of matrices and determinants, including their notation, terminology, and importance in various fields. • Demonstrate knowledge of determinant properties and their application in simplifying expressions and solving problems. • Explain the Vedic Mathematics techniques used to solve 3x3 and 4x4 determinants and understand the rationale behind these methods.
2	**Application**	• Apply determinant properties to solve determinant-based problems and analyze their real-world applications in mathematics, physics, and computer science. • Utilize Vedic Mathematics methods, such as Urdhva Tiryagbhyam and sutras like Paravartya Yojayet and Anurupye Sunyamanyat, to solve systems of simultaneous linear equations. • Implement matrix inversion techniques, including the adjoint method and elementary row operations, to find the inverse of matrices and solve systems of equations.
3	**Analysis**	• Analyze the historical evolution of matrices and determinants, including the contributions of ancient Indian mathematicians, and evaluate their significance in modern mathematics. • Critically evaluate the effectiveness and efficiency of Vedic Mathematics techniques in solving determinants and simultaneous linear equations, considering their advantages and limitations.
4	**Synthesis**	• Synthesize knowledge of determinant properties, Vedic Mathematics methods, and matrix inversion techniques to solve complex problems involving matrices, determinants, and systems of equations. • Design and develop innovative problem-solving strategies using Vedic sutras and techniques for simultaneous equation solving, demonstrating creativity and originality in mathematical thinking.
5	**Evaluation**	• Evaluate the accuracy and reliability of solutions obtained using determinant properties, Vedic Mathematics methods, and matrix inversion techniques, and assess their suitability for different problem contexts. • Critically assess the applicability and practicality of Vedic Mathematics techniques in various mathematical and real-world scenarios, considering their efficiency, computational complexity, and versatility.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	2	1		
CO 2	1	1	1	1	
CO 3	1	2	1		
CO 4		1	2		
CO 5	1	2	1		

Detailed syllabus:

Unit	Content (1 credit Theory)	No. of theory Hours
1	**Introduction and History of Matrices and Determinants** • Introduction to matrices and determinants: Definition, notation, and basic terminology. • Historical development of matrices and determinants, including contributions from ancient Indian mathematicians. • Importance of matrices and determinants in various fields, such as mathematics, physics, and computer science. **Properties of Determinants** • Understanding the properties of determinants: Linearity, alternating property, and scalar multiplication property. • Application of properties in simplifying determinant expressions and solving determinant-based problems. • Illustration of properties through practical examples and exercises.	5
2	**Vedic Methods to Solve 3x3 and 4x4 Determinants (Urdhva Tiryagbhyam)** • Introduction to Vedic Mathematics techniques for solving determinants. • Detailed explanation of Urdhva Tiryagbhyam method for 3x3 and 4x4 determinants. • Step-by-step demonstration of applying Vedic sutras to simplify determinant calculations. • Practice sessions to reinforce understanding and proficiency in using Vedic methods. **Inverse of Matrices** • Understanding the concept of matrix inverses and their properties. • Methods for finding the inverse of a matrix: Adjoint method, elementary row operations. • Application of matrix inverses in solving systems of linear equations and other mathematical problems. Practice exercises and real-world applications of matrix inversion.	5

3	**Paravartya Yojayet and Anurupye Sunyamanyat** • Introduction to Vedic sutras for solving simultaneous linear equations. • Explanation of Paravartya Yojayet (Transpose and Apply) and Anurupye Sunyamanyat (Proportionately Equal Remainders) sutras. • Application of sutras in solving systems of linear equations with multiple variables. • Practice sessions to master the use of Vedic sutras in solving linear equations. **Sankalana Vyavakalana-bhyam** • Introduction to the Sankalana Vyavakalana-bhyam (Combine and Separate) Vedic sutra. • Application of the sutra in solving systems of linear equations involving addition and subtraction operations. • Advanced problem-solving using Vedic methods for simultaneous linear equations. • Collaborative exercises and discussions to explore various strategies and approaches.	5
Sr. No.	**Content (1 credit Practical)**	**No. of practical's Hours**
1	**Practical Title 1: Matrices and Determinants Through Time** • Explore the historical development of matrices and determinants, focusing on contributions from ancient Indian mathematicians. • Analyze the evolution of notation, terminology, and basic concepts related to matrices and determinants. • Discuss the importance and applications of matrices and determinants in various fields over different historical periods. • Engage in group discussions and presentations to showcase key milestones in the history of matrices and determinants.	5
2	**Practical Title 2: Properties of Determinants in Action** • Investigate the properties of determinants through practical examples and exercises. • Apply determinant properties, such as linearity and scalar multiplication, to simplify expressions and solve determinant-based problems. • Work on challenging exercises to reinforce understanding of determinant properties and their applications in real-world scenarios. • Collaborate with peers to analyze and discuss the significance of determinant properties in mathematical contexts.	5
3	**Practical Title 3: Vedic Determinant Techniques Workshop** • Learn and practice Vedic Mathematics techniques, specifically Urdhva Tiryagbhyam, for solving 3x3 and 4x4 determinants. • Participate in step-by-step demonstrations of applying Vedic sutras to simplify determinant calculations. • Engage in hands-on practice sessions to reinforce proficiency in using Vedic methods for determinant solving. • Collaborate with classmates to solve complex determinant problems and discuss alternative problem-solving strategies.	
4	**Practical Title 4: Matrix Inversion Mastery** • Apply methods for finding the inverse of a matrix, including the adjoint method and elementary row operations. • Practice using matrix inverses in solving systems of linear equations and other mathematical problems.	5

	• Explore real-world applications of matrix inversion in fields such as engineering and computer science. • Work on practice exercises and case studies to deepen understanding and proficiency in matrix inversion techniques.	
5	**Practical Title 5: Vedic Sutras for Simultaneous Equations** • Learn and master Vedic sutras, such as Paravartya Yojayet and Anurupye Sunyamanyat, for solving systems of simultaneous linear equations. • Participate in guided practice sessions to apply Vedic sutras in solving systems with multiple variables. • Engage in problem-solving challenges to enhance speed and accuracy in using Vedic methods for simultaneous equation solving. • Collaborate with classmates to explore various strategies and approaches for solving complex simultaneous equations.	5
6	**Practical Title 6: Advanced Simultaneous Equations with Vedic Sutras** • Explore advanced Vedic sutras, including Sankalana Vyavakalana-bhyam, for solving systems of linear equations involving addition and subtraction operations. • Apply Vedic methods to solve complex simultaneous equations and analyze the results. • Engage in collaborative exercises and discussions to explore alternative problem-solving strategies and approaches. • Work on challenging problem sets and case studies to deepen understanding and proficiency in using Vedic techniques for simultaneous equation solving.	5

Suggested Reference books.

6. Advanced Vedic Mathematics Rajeshkumar thakur, Rupa publications pvt. Ltd. 2019
7. Tirtha, Bharati Krishna. Vedic Mathematics. Publisher: Motilal Banarsidass, Year of Publication: 1965.
8. Williams, Kenneth. The Cosmic Calculator: Vedic Mathematics. Publisher: CreateSpace Independent Publishing Platform, Year of Publication: 2014.
9. Handley, Bill. Speed Mathematics Using the Vedic System. Publisher: John Wiley & Sons, Year of Publication: 2003.
10. Bathia, Dhaval. Vedic Mathematics Made Easy. Publisher: Jaico Publishing House, Year of Publication: 2006.