MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

College with Potential for Excellence
NAAC Accredited 'A+' Grade Institution

Email: mac@macollege.inwww.macollege.in

SCHEME AND SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

(MAC- UG-CBCS 2021)

IN

B.Sc MATHEMATICS PROGRAMME

MACUGSMAT1003

EFFECTIVE FROM THE ACADEMIC YEAR 2021-22

BOARD OF STUDIES IN MATHEMATICS (UG)

ACADEMIC COUNCIL

COMPOSITION – With Effect From 01-06-2020

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Principal
Mar Athanasius College (Autonomous), Kothamangalam

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6. **Dr. M.C. Dileep Kumar**
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SreeSankaracharya Sanskrit University
Kalady, Kerala, India

7. **Dr. Mathew. K.**
Principal
Mar Athanasius College of Engineering,
Kothamangalam, Kerala - 686 666

8. **Adv. George Jacob**
Senior Advocate
High Court of Kerala

Nominees of the University not less than Professors

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SAS SNDP Yogam College
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10. **Dr. Suma Mary Sacharia**
UC College
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11. **Dr. V. B. Nishi**
Associate Professor
Sree Shankara College, Kalady.

Member Secretary

12. **Dr. M. S. Vijayakumary**
Dean – Academics
Mar Athanasius College (Autonomous)
Kothamangalam

Four teachers of the college representing different categories of teaching staff by rotation on the basis of seniority of service in the college.

13. Dr. Bino Sebastian. V (Controller of Examinations)

14. Dr. Manju Kurian, Asst. Professor, Department of Chemistry

15. Dr. Smitha Thankachan, Asst. Professor, Department of Physics

16. Dr. Asha Mathai, Asst. Professor, Department of Malayalam

Heads of the Departments

17. Dr. Jayamma Francis, Head, Department of Chemistry

18. Dr. Mini Varghese, Head, Department of Hindi

19. Ms. Shiny John, Head, Department of Computer Science

20. Dr. Igy George, Head, Department of Economics

21. Dr. Rajesh.K. Thumbakara, Head, Department of Mathematics

22. Dr. Aji Abraham, Head, Department of Botany

23. Dr. Selven S., Head, Department of Zoology

24. Dr. Deepa. S, Head, Department of Physics

25. Dr. Aswathy Balachandran, Head, Department of English

26. Dr. Diana Ann Issac, Head, Department of Commerce

27. Ms. Seena John, Head, Department of Malayalam

28. Ms. Diana Mathews, Head, Department of Sociology

29. Ms. Sudha. V, Head, Department of Statistics

30. Dr. Jani Chungath, Head, Department of History

31. Sri. Haary Benny Chettiamkudiyil, Head, Department of Physical Education

32. Ms. Shari Sadasivan, Head, Department of Marketing and International Business

33. Dr. Julie Jacob, Head, Department of Biochemistry

34. Ms. NivyaMariyam Paul, Head, Department of Microbiology

35. Ms. Jaya Vinny Eappen, Head, Department of Biotechnology

36. Ms. Shalini Binu, Head, Department of Actuarial Science

37. Ms. Simi. C.V, Head, Post Graduate Department of History

38. Ms. Sari Thomas, Head, Post Graduate Department of Statistics

39. Ms. Sheeba Stephen, Head, Department of B.Com Model III- Tax Procedure and Practice

40. Ms. Dilmol Varghese , Head, Post Graduate Department of Zoology

41. Ms. Bibin Paul, Head, Post Graduate Department of Sociology

BOARD OF STUDIES IN MATHEMATICS(UG)

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Dr. Latha S. Nair	Associate Professor
Dr. Bino Sebastian V.	Assistant Professor
Dr. Susan Ray Joseph	Assistant Professor
Dr. Mary Elizabeth Antony	Assistant Professor

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PREFACE

The courses for the UG Programme are framed using time tested and internationally popular text books so that the courses are at par with the courses offered by any other reputed universities and institutions around the world.

Only those concepts that can be introduced at the UG level are selected and instead of cramming the course with too many ideas the stress is given in doing the selected concepts rigorously. The idea is to make learning mathematics meaningful and an enjoyable activity rather than acquiring manipulative skills and reducing the whole thing an exercise in using thumb rules.

Every student has to do a project during 6^{th} semester. The topics for the project can be selected as early as the beginning of the 4^{th} semester.

Course Structure:

The U.G. Programme in Mathematics must include (a) Common courses, (b) Core courses, (c) Complementary Courses, (d) Open Courses and (e) Project and no course shall carry more than 4 credits. The student shall select any Choice based course offered by the institution depending on the availability of teachers and infrastructure facilities in the institution. Open course may be offered in any subject and the student shall have the option to do courses offered by other departments/ or by the same department.

Courses:

The number of Courses for the restricted programme should contain 12 core courses and 1 choice based course from the frontier area of the core courses, one open course offered by the department, 8 complementary courses, from the relevant subjects for complementing the core study. There should be 10 common courses, or otherwise specified, which includes the first and second language of study.

Objectives :

The syllabi are framed in such a way that it bridges the gap between the plus two and post graduate levels of Mathematics by providing a more complete and logic frame work in almost all areas of basic Mathematics.

By the end of the second semester, the students should have attained a common level in basic Mathematics, a secure foundation in Mathematics and other relevant subjects to complement the core for their future courses.

By the end of the fourth semester, the students should have been introduced to powerful tools for tackling a wide range of topics in Calculus, Theory of Equations and Numerical methods. They should have been familiar with additional relevant mathematical techniques and other relevant subjects to complement the core.

By the end of sixth semester, the students should have covered a range of topics in almost all areas of Mathematics, and had experience of independent works such as project, seminar etc.

Chairman and Members

Board of Studies of Mathematics (UG)
Mar Athanasius College (Autonomous),
Kothamangalam

LIST OF UNDERGRADUATE PROGRAMMES IN MAR ATHANASIUS COLLEGE (AUTONOMOUS), KOTHAMANGALAM

SL. NO.	PROGRAMME	DEGREE	FACULTY
1	ENGLISH	BA	LANGUAGE AND LITERATURE
2	HINDI	BA	LANGUAGE AND LITERATURE
3	ECONOMICS	BA	SOCIAL SCIENCES
4	SOCIOLOGY	BA	SOCIAL SCIENCES
5	HISTORY	BA	SOCIAL SCIENCES
6	MATHEMATICS	B.Sc	SCIENCE
7	CHEMISTRY	B.Sc	SCIENCE
8	PHYSICS	B.Sc	SCIENCE
9	BOTANY	B.Sc	SCIENCE
10	STATISTICS	B.Sc	SCIENCE
11	ZOOLOGY	B.Sc	SCIENCE
12	COMMERCE (SPECIALISATION - FINANCE AND TAXATION) – MODEL - I	B.Com	COMMERCE
13	COMMERCE - (SPECIALISATION – TAXATION) MODEL – III (SELF FINANCING)	B.Com	COMMERCE
14	BUSINESS ACCOUNTING AND TAXATION	B.Voc	COMMERCE
15	DATA ANALYTICS AND MACHINE LEARNING	B. Voc	SCIENCE

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA - 686666

REGULATIONS OF THE UNDERGRADUATE PROGRAMMES

UNDER CHOICE BASED CREDIT SYSTEM

(MAC- UG-CBCS 2021)

(2021 Admission onwards)

PREAMBLE

Education prepares a man to live with dignity and liberty. The ultimate aim of education is to deepen man's understanding of the universe and of himself-in body, mind and spirit –and to disseminate this understanding throughout society and to apply it in the service of mankind. This aim is accomplished when quality is ensured in the process of learning. Ever since Independence there has been several attempts on the part of Central and State Governments, University Grants Commission, AICTE and similar regulatory bodies as well as universities and colleges to improve the quality of instruction offered. However, because of heavy demand for access and consequent expansion of colleges and universities together with constraints on resources, standards of education could not cope with expansion. The affiliating system, which played a useful role in managing access in the past, occupied disproportionate time on administration of the system and undermined the capacities of universities and colleges to work towards research and development. Even curricular reform took a back seat in many universities. While there is no alternative in the present context to the system of affiliation, there is a felt need to seek fresh strategies for innovation and experimentation in the entire range of higher education activities at the institutional level. In this scenario, Government of India by Resolution dated 14 July 1964 appointed the Education Commission to advise Government on the national pattern of education and policies for the development of education at all stages and in all aspects. The Education Commission (1964 – 66) recommended "Autonomy" to Universities and colleges as instrumental in achieving and promoting academic excellence in higher education (Chapter XIII). In consonance with this recommendation, the University Grants Commission prepared Guidelines for Autonomy (Annexure II)duringXIth plan and the same has been revised subsequently during

XIIth plan. In the context of UGC Guidelines, the Committee set up by the Kerala State Higher Education Council in December 2012 to recommend criteria for selection and steps for operationalization of "Autonomous Colleges" in Kerala, deliberated on the subject extensively. Accordingly, the 13th Kerala State Legislative Assembly as per the "the University Laws (Third Amendment) Bill, 2014 resolved to provide Autonomy to colleges and Universities in Kerala. Mar Athanasius College, Kothamangalam, in its pursuit of academic excellence, was accorded Autonomous Status as per the Letter No. F.22 – 1/2016 (AC), dated 9th March, 2016. Following the attainment of autonomous status, the expert committee constituted by the Principal has undertaken the task of designing a draft Regulations and Guidelines of all Undergraduate Programmes in the institution in 2016. During the academic year 2016-17(For the 2016 admission) the then prevailing M. G. University regulations was accepted by the institution without any change. In the academic year 2017 the institution prepared UG regulations after making necessary modifications. The total credit, internal assessment, evaluation of answer sheets, Question paper pattern and conduct of examination were strictly adherent to the parent university regulations. The modified regulation came in to force in academic year 2018(with effect 2018 admission onwards) and the same regulation continued until 2020-21. In due course as per the recommendations of the academic council held on 19.06.2020, the 2018 UG regulations has been hitherto, modified by incorporating the modifications put forward by M.G. University as per U.O No. 1417/AC A9/2020 MGU Dated10.03.2020. The framework of the Common Guidelines and regulations are presented in the ensuing pages.

1. TITLE

1.1. These regulations shall be called **"REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, 2021 (MAC- UG-CBCS 21)"** of Mar Athanasius College (Autonomous), Kothamangalam.

2. SCOPE

2.1 Applicable to all Undergraduate Programmes conducted by Mar Athanasius College (Autonomous), Kothamangalam with effect from 2021-22 admissions.

2.2 Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

3. DEFINITIONS

3.1. ***'Academic Week'*** is a unit of five working days in which distribution of work is organized from Day One to Day Five, with five contact hours of one hour duration on each day.

3.2 '***Semester'*** means a term consisting of a minimum of 90 working days, inclusive of tutorials, examination days and other academic activities, within a period of six months.

3.3 ***'Programme'*** means a three year programme of study with examinations spread over six semesters.The successful completion of the programme leads to the award of a Bachelor Degree.

3.4 ***'Course'*** means a portion of a subject, which will be taught and evaluated in a semester (similar to a paper under Annual scheme). Each Course is to be designed under lectures / tutorials / laboratory / fieldwork / seminar/ project / practical training / assignments and evaluation etc., to meet effective teaching and learning needs.

3.5. ***'Common Course I'*** means a course that comes under the category of courses for English.

3.6 ***'Common Course II'*** means additional language (Malayalam or Hindi).

3.7. ***'Core Course'*** means a course in the subject of specialization within an Under Graduate Programme.It includes a course on environmental studies and human rights.

3.8. ***'Complementary Course'*** means a course which would enrich the study of core courses.

3.9. ***'Choice Based Course'*** means a course that enables the students to familiarise the advanced areas of Core Course.

3.10. ***'Open course'***means an optional course which the student is free to take at his/her will. Open Course shall be a non-major elective course offered by the Departments other than parent Department.

3.11 '***Certificate Course / Diploma Course'*** meanscourses that permit an opportunity to the students for academic enrichment in an area other than the traditional programmes to which he/she is admitted. Such courses will lead the candidate toward entry level employment in a professional field. The duration and general frame of the courses are subject to the regulations prescribed by the UGC from time to time. Certificate/Diploma courses shall be conducted over and above regular working hours.

3.12. *'**Credit'*** is the numerical value assigned to a course according to the relative importance of the syllabus of the programme**.**

3.13. ***'Grade'*** means a letter symbol (e.g: A, B, C, etc.) that indicates the broad level of performance of a student in a course/ semester/programme.

3.14. ***'Grade Point' (GP)***is the numerical indicator of the percentage of marks awarded to a student in a course.

3.15. **Institutional Average (IA)** means average marks secured (Internal + External) for a course at the college level

3.16. ***'Credit Point (CP)'***of a course is the value obtained by multiplying the Grade Point (GP) by the Credit (C) of the course. CP=GP x C.

3.17. ***'Cumulative Credit Point Average (CCPA)'*** is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits.

3.18. ***'Department'*** meansany Teaching Department in the College.

3.19. '***Parent Department'***means the department which offers core courses within an Under Graduate Programme.

3.20. ***'Department Council'*** means the body of all teachers of a department in the college.

3.21. *'**Department Co-ordinator'***means a teacher from the parent department nominated by the Department Council, who will advise the student in the academic matters.

3.22. ***'College Coordinator'***is a teacher nominated by the Principal to co-ordinate the continuous evaluation undertaken by various departments within the college.

3.23. '***Grace Marks'***means marks awarded to the candidates as per theorders issued by Mahatma Gandhi University, Kottayam, from time to time.

3.24. ***'Skill Enhancement Programme'*** meansProgramme intended to assist the students to acquire additional practical skill which should be conducted over and above the regular working hours.

3.24. Words and expressions used and not defined in this regulation shall have thesamemeaning assigned to them in the Act and Statutes of the Mahatma Gandhi University.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility and Norms for admission and reservation of seats for various Under Graduate Programmes shall be according to the rules framed by the Mahatma Gandhi University/State Government from time to time.

5. DURATION

5.1 The duration of UG programmes shall be ***6 semesters***.

5.2 There shall be two semesters in an academic year. The **ODD** semester commences in**June**and on completion, the **EVEN** semestercommences.There shall be twomonths' vacation during April and May in every academic year.

5.3 A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

6. REGISTRATION

6.1 The strength of students for each course shall remain as per existing regulations as approved by Mahatma Gandhi University, Kottayam.

6.2 The college shall send a list of students registered for each programme in each semestergiving the details of courses registered to the University in the prescribed form within 45 days from the commencement of the Semester.

6.3 Those students who possess the required minimum attendance and progress during a semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned, enabling them to get promoted to the next class.

7. SCHEME AND SYLLABI

7.1. The UG programmes shall include (a) Common courses I and II, (b) Core courses, (c) Complementary Courses, (d) Choice Based Course and(e) Open Course. Common course II is exempted in the case of B.Com Model III.

7.2. There shall be one Choice Based course (Elective Course) in the sixth semester. In thecase of B.Com Programme there shall be an elective stream from third semesteronwards.

7.3 Credit Transfer and Accumulation System can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one College to continue their education in another College without break. Credit transfer shall be permitted as per the University Rules.

7.4. A separate minimum of 30% marks each for internal and external (for both theory and practical) and an aggregate minimum of 35% are required to pass a course. For a pass in a programme, a separate minimum of **Grade D**is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme only **F Gradewill be awarded** for that Semester/Programme until he/she improves this to **D Grade** or above within the permitted period.

7.5. Students who complete the programme with "D" Grade under **"REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, 2021 – MAC – UG- -CBCS 2021"** of Mar Athanasius College (Autonomous), Kothamangalam will have **one betterment chance within 12 months**, immediately after the publication of the result of the whole programme.

7.6 The UG Board of Studies concerned shall design all the courses offered in the UG programme. The Boards shall design new courses and modify or re-design existing courses to facilitate better exposure and training for the students.

7.7. The syllabus of a course shall include the title of the course, contact hours, the number of credits and reference materials.

7.8. Students discontinued from previous regulations CBCS 2018 of Mar Athanasius College (Autonomous), Kothamangalam can pursue their studies in the Mar Athanasius College (Autonomous) Kothamangalam under "Regulations for Under Graduate Programmes under Choice Based Credit System 2021"after obtaining readmission. These students have to complete the programme as per the Mar Athanasius College (Autonomous)"Regulations for Under Graduate Programmes under Choice Based Credit System 2021 (MAC – UG – CBCS 2021)".

7.9. The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which are in need of conducting practical examinations at the end of odd semesters

8. PROGRAMME STRUCTURE

The structure of UG Programmes is as follows

Model I B.A/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from **common course I**	22
d	Credits required from **common course II**	16
e	Credits required from Core Course and Complementary Course including Project	79
f	Credits required from Open course	3
g	Minimum attendance required	75%

Model I B Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from **common course I**	14
d	Credits required from **common course II**	8
e	Credits required from Core Course and Complementary Course	95
f	Credits required from Open course	3
g	Minimum attendance required	75%

Model III B Com

a	Programme Duration	6 semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from **Common Course I**	8
d	Credits required from Core + Complementary + Vocational courses including Project	109
E	Credits required from Open Course	3
G	Minimum attendance required	75%

9. EXAMINATIONS

9.1 The evaluation of each course shall contain two parts:

(i) Internal or In-Semester Assessment (ISA)

(ii) External or End-Semester Assessment (ESA)

The in-semester to end semester assessment ratio shall be 1:4.

Both Internal and External marks are to be rounded to the next integer.

9.2 For all courses (theory & practical), grades are given on a **10- point scale,** based on the total percentage of marks ***(ISA+ESA)*** as given below:

Percentage of Marks	Grade	Grade Point (GP)
95 and above	SOutstanding	10
85 to below 95	A+Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B+Good	7
55 to below 65	B Above average	6
45 to below 55	CSatisfactory	5
35 to below 45	DPass	4
Below 35	F Failure	0
	AbAbsent	0

10. CREDIT POINT(CP)AND CREDIT POINT AVERAGE (CPA)

1. Credit Point (CP)

Credit Point (CP) of a paper is calculated using the following formula.

CP = C × GP
Where:
C is the Credit and
GP is the Grade point

2. Credit Point Average (CPA)

Credit Point Average (CPA) of a Course (Common Course I, Common Course II, complementary Course I, Complementary Course II, and Core Course) is calculated using the following formula.

CPA = TCP/TC

Where:
TCPis the Total Credit Point of course and
TC is the Total Credit of that category of course

3. Semester Credit Point Average (SCPA)

Semester Credit Point Average (SCPA) of a Semester is calculated using the following formula.

SCPA = TCP/TC

Where:
TCP is the Total Credit Point of that semester and
TC is the Total Credit of that semester

4. Cumulative Credit Point Average (CCPA)

Cumulative Credit Point Average (CCPA) is calculated using the following formula.

CCPA = TCP/TC

Where;
TCP is the Total Credit Point of that Programme and
TC is the Total Credit of that programme

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	**Grade**
9.5 and above	S Outstanding
8.5 to below 9.5	A^+Excellent
7.5 to below 8.5	A Very Good
6.5 to below 7.5	B^+Good
5.5 to below 6.5	B Above average
4.5 to below 5.5	CSatisfactory
4to below 4.5	DPass
Below 4	F Failure

11. MARK DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATION

The end semester examinations of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practical total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

11.1 FOR ALL COURSES WITHOUT PRACTICAL

a) Marks of External Examination : 80

b) Marks of Internal Evaluation : 20

All the four components of the internal assessment are mandatory.

Components of Internal Evaluation of theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5)	**10**
Total	**20**

11.2 FOR ALL COURSES WITH PRACTICAL

a) Marks of External Examination :60

b) Marks of Internal Evaluation : 15

11.2.1 FOR THEORY

Components of In-Semester Evaluation of Theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**2**
Test papers (2x4)	**8**
Total	**15**

11.2.2 FOR PRACTICAL EXAMINATION

a) External 40

b) Internal 10

Components of In-Semester Evaluation of Practical	**Marks**
Attendance	2
Test papers (1x4)	4
Record*	4
Total	**10**

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are Mandatory.

11.3 PROJECT EVALUATION: (Maximum Marks 100)

All students are to do a project in the area of core course. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. Special sanction shall be obtained from the Principal to those new generation programmes and programmes on performing arts where students have to take projects which involve larger groups. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners (Internal and External) appointed by the Controller of Examinations. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

For Projects

a) Marks of External Evaluation :80

b) Marks of Internal Evaluation : 20

Components of External Evaluation of Project	**Marks**
Dissertation (**External)**	50
Viva – Voce (**External)**	30
Total	**80**

*Marks for Dissertation may include study tour report if proposed in the syllabus

*Components of Internal Evaluation of Project	Marks
Punctuality	5
Experimentation/Data collection	5
Knowledge	5
Report	5
Total	**20**

11.4 ATTENDANCE EVALUATION FOR ALL COURSES (Theory/Practical)

Percentage of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1
Below 75	0

(Decimals are to be rounded to the next higher whole number)

12. ASSIGNMENTS

Assignments are to be done from first to fourth Semesters. At least one assignment should be done in each semester.

13. SEMINAR/VIVA VOCE

A student shall present a seminar in the Fifth semester for each courseand appear for Viva-voce in the sixth semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

Two Test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teaches the course.

14.1 GRIEVANCE REDRESSAL MECHANISM

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has every right to know, how the teacher arrived at the marks. In order to address the grievance of students, a three -level Grievance RedressalMechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: At the level of the concerned Course Teacher

Level 2: **Department Level**: The Department cell chaired by the Head of the Department, Faculty Advisorandthe Course Teacher concerned as members.

Level 3: **College level**: A committee with the Principal as Chairman, and HOD of concerned Department, Academic Coordinator, and two teachers ofthe College Grievance Cell as members.

14.2 Academic coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of first semester.

14.3 The in-semester evaluation report in the prescribed format should reach theController of Examinations as per the academic calendar.

14.4 The evaluation of all components is to be published in the Department and is to be acknowledged by the candidates. All academic records of in-semester assessments are to be kept in the Department for three years and shall be made available for verification. The responsibility of evaluating the in-semester assessment is vested on the teacher(s), who teach the course.

15. EXTERNAL EXAMINATION

The end semester examination of all Programmes shall be conducted by the College at the end of each semester.

15.1 Students having a minimum of 75% average attendance for all the courses only can register for the examination. A candidate having a shortage of attendance of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme can apply for Condonation in prescribed form on genuine grounds. This Condonation shall not be counted for internal assessment. Condonation of shortage of attendance, if any, should be obtained at least 7 days before the commencement of the concerned semester examination.

It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned Faculty Advisor and Head of the Department.

Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also.

Those students who are not eligible to attend the end semester examination due to shortage of attendance, even with Condonation, should take re-admission along with the next batch.

15.2 Those candidates who cannot appear for End Semester Examination or who have failed in the end semester examinations of Fifth and Sixth Semester shall be eligible to appear for supplementary examination by paying separate fees. For reappearance/ improvement, for other semesters the students can appear along with the next batch. Notionally registered candidates can also apply for the said supplementary examinations.

15.3 A student who registers his/her name for the end semester examination will be eligible for promotion to the next semester.

15.4 A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

15.5 A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the End Semester examination for the same semester, subsequently. There shall be no improvement for internal evaluation.

15.6 Answer scripts of the external examination shall be made available to the students for scrutiny on request and revaluation/scrutiny of answer scripts shall be done as per the request of the candidate by paying fees.

16. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/she shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

Pattern of Questions for External Examination for Course without Practical

Sl. No.	Pattern	Marks	Choice of questions	Total Marks
1	Short answer/ Problem Type	2	10/12	20
2	Short essay/ Problems	5	6/9	30
3	Essay/Problem	15	2/4	30
Total				80

Pattern of Questions for End Semester Examination for Course with Practical

Sl. No.	Pattern	Marks	Choice of questions	Total Marks
1	Short answer/ Problem Type	1	10/12	10
2	Short essay/ Problems	5	6/9	30
3	Essay/Problem	10	2/4	20
Total				60

17. RANK CERTIFICATE

The institution publishes rank list of top 3 candidates for each programme after the publication of 6th semester results. Rank certificate shall be issued to the candidate who secure first position in the rank list. Candidates shall be ranked in the order of merit based on the CCPA scored by them. Grace marks awarded to the students should not be counted fixing the rank/position.Rank certificate shall be signed by the Principal and Controller of Examinations.

18. MARK CUM GRADE CARD

The College under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each semester, which shall contain the following information:

(a) Name of the University

(b) Name of the College

(c) Title & Model of the Under-Graduate Programme

(d) Name of the Semester

(e) Name and Register Number of the student

(f) Code, Title, Credits and Maximum Marks (Internal, External and Total) of each course opted in the semester.

(g) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester

(h) Institutional average of the Internal Exam and Average of the External Exam in each course.

(i) The total credits, total marks (Maximum and Awarded) and total credit points in the semester

(j) Semester Credit Point Average (SCPA) and corresponding Grade.

(k) Cumulative Credit Point Average (CCPA), CPA corresponding to Common courses I and II, Core Course, Complementary Course and Open Course.

(m) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination and shall include the final grade(SCPA) scored by the candidate from **1st to 5th** semesters, and the overall grade for the total programme.

19. There shall be 2 level monitoring committees for the successful conduct of the scheme. They are:

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior most teachers as members.
2. College Level Monitoring Committee (CLMC), comprising Principal, College Council secretary and A.O/Superintendent as members.

20. SKILL ENHANCEMENT PROGRAMME

In addition to the requirement prescribed for the award of Bachelor degree, each student shall participate in the Skill Enhancement Programme (SEP) conducted by each department for a total duration of 40 hours spread over Semester I to Semester VI of all Programmes. SEP is intended to train the students and to inculcate extra skills that enable them to be competent in academic and non-academic matters equally. Separate certificate shall be issued by the institution to the candidate on successful completion of the programme. SEP shall be conducted over and above the regular working hours of each programme.

21. CERTIFICATE/DIPLOMA COURSES: Certificate/Diploma courses such as basics of accounting, animation, photography, garment designing, etc. may be conducted for all Programmes as per the discretion of the Board of Studies of the concerned department. The Board of Studies should prepare the curriculum and Syllabi of Certificate/Diploma courses including contact hours and reference materials. Separate certificate will be issued to the candidate on successful completion of the course. An extra Credit of 2 will be awarded to all the candidates on successful completion of the certificate courses and same shall be inscribed in the cumulative grade card and the degree certificate of each candidate.

21. A FACTORY VISIT / FIELD WORK/VISIT TO A REPUTED RESEARCH INSTITUTE/ STUDENT INTERACTION WITH RENOWNED ACADEMICIANSmay be conducted for all Programmes.

22. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any Programme with such modifications as may be necessary from time to time.

Annexure I – Model Mark cum Grade Card

MarAthanasius College(Autonomous) Kothamangalam

Kothamangalam College P.O. Kothamangalam.

Section:

Student ID:

Date:

MARK CUM GRADE CARD

Name of candidate :

Name of College :

Permanent Register Number (PRN) : Degree:

Name of the Programme :

Name of Examination :First Semester Exam Month &Year

Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP)	Credit point (CxGP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (E+i)	Maximum	Awarded (I)	Maximum					
	Common Course I Common Course II Core Course Complementary Course I Complementary Course II/ Vocational Course Total Total credit points (TCP) Total credit (TC) SCPA: Grade:												

Annexure II Model Mark cum Grade Card (VI Semester)

Mar Athanasius College (Autonomous) Kothamangalam
Kothamangalam College P.O. Kothamangalam.

Section:
Student ID:
Date:

MARK CUM GRADE CARD

Name of candidate :
Name of College :
Permanent Register Number (PRN) : Degree:
Name of the Programme :
Name of Examination :Sixth Semester Exam Month &Year
Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP)	Credit point (CxGP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (E+i)	Maximum	Awarded (I)	Maximum					
	Core 9 Core 10 Core 11 Core 12 Choice Based Course Project SCPA Grade												

		Credit	CPA	Grade	Month & Year	Result
	Semester I Semester II Semester III Semester IV Semester V Semester VI					
	Common Course I Common Course II Complementary Course I Complementary Course II Core Course Open Course					
	Overall programme CCPA:					

Annexure III

Reverse side of the Mark cum Grade Card

(COMMON TO ALL SEMESTERS)

Description of the Evaluation Process

Grade and Grade Point

The Evaluation of each Course comprises of Internal and External Components in the ratio 1:4 for all Courses.

Grades and Grade Points are given on a 10-point Scale based on the percentage of Total Marks (Internal + External) as given in Table 1.

(Decimals are to be rounded to the next whole number)

Credit point and Credit point average. Grades for the different Semesters and overall Programme are given based on the corresponding CPA, as shown in Table I.

Table 1

Percentage of Marks	Grade	Grade Point (GP)
95 and above	S Outstanding	10
85 to below 95	A+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B+ Good	7
55 to below 65	B Above average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4
Below 35	F Failure	0
	Ab Absent	0

Credit point (CP) of a paper is calculated using the formula CP = C x G P, where C is the Credit; GP is the Grade Point.

Credit Point Average (CPA) of a Course/ Semester or Programme (cumulative) etc. is calculated using the formula CPA =TCP/TC; where TCP is the Total Credit Point; TC is the Total Credit.

For converting SCPA into Percentage, multiply secured SCPA by 10 (SCPA x 10)

For converting CCPA into percentage, multiply secured CCPA by 10 (CCPA x 10)

CPA	GRADE
Equal to 9.5 and above	S Outstanding
Equal to 8.5 and < 9.5	A+ Excellent
Equal to7.5 and < 8.5	A Very Good
Equal to 6.5 and < 7.5	B+ Good
Equal to5.5 and < 6.5	B Above Average
Equal to4.5 and < 5.5	C Satisfactory
Equal to 4 and < 4.5	D Pass
Below 4	F Failure

Note: A separate minimum of **30%** marks each for internal and external (for both theory andpractical) and aggregate minimum of **35%** are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme only **F grade** will be awarded for that Semester/Programme until he/she improves this to **D grade** or above within the permitted period.

ELIGIBILITY FOR ADMISSION

Admission to B.Sc. Mathematics programme shall be open only to candidates who have passed the Plus Two or equivalent examination or an examination recognized by Mahatma Gandhi University, Kottayam as equivalent thereto with Mathematics as one of the optional subjects. Mathematics as one of the subjects in Commerce group.

SCHEME AND STRUCTURE OF B.Sc MATHEMATICS PROGRAMME

CURRICULUM FOR B.Sc MATHEMATICS MODEL I

Course Structure

Total Credits :-120(Eng:22+S.Lang:16+Complementary:28+Open:4+Core:50)

Total hours :-150(Eng:28+S.Lang:18+Complementary:36+Open:4+Core:64)

Sl: No	Semester	Papers	Hours	Credits	Internal Marks	External Marks	Total Marks
1	**I**	English I	5	4	20	80	100
		English /Common course I	4	3	20	80	100
		Second Language I	4	4	20	80	100
		Mathematics Core Course - 1	4	3	20	80	100
		Complimentary1 Course - 1 (Statistics)	4	3	20	80	100
		Complimentary 2 Course – 1 (Physics)	2 **(T)**	2	10	60	70
			2 **(P)**	0			
	Total		**25**	**19**			**570**
2	**II**	English II	5	4	20	80	100
		English /Common course II	4	3	20	80	100
		Second Language II	4	4	20	80	100
		Mathematics Core Course- 2	4	3	20	80	100
		Complimentary1 Course –II (Statistics)	4	3	20	80	100
		Complimentary2 Course-II (Physics/)	2 **(T)**	2	10	60	70
			2 **(P)**	2	20	40	60
	Total		**25**	**21**			**630**
3	**III**	English III	5	4	20	80	100
		Sec. Lang./Common course I	5	4	20	80	100
		Mathematics Core Course – 3	5	4	20	80	100

		Complimentary1 Course – II (Statistics)	5	4	20	80	100
		Complimentary2 Course –II (Physics)	3 **(T)**	3	10	60	70
			2 **(P)**	0			
	Total		**25**	**19**			**470**
4	**IV**	English IV	5	4	20	80	100
		Sec. Lang./Common courseII	5	4	20	80	100
		Mathematics Core Course – 4	5	4	20	80	100
		Complimentary1 Course III	5	4	20	80	100
		Complimentary2 Course III (Physics)	3 **(T)**	3	10	60	70
			2 **(P)**	2	20	40	60
	Total		**25**	**21**			**530**
5	**V**	Mathematics Core Course – 5	6	4	20	80	100
		Mathematics Core Course – 6	6	4	20	80	100
		Mathematics Core Course – 7	5	4	20	80	100
		Human Rights and Mathematics for Environmental Studies	4	4	20	80	100
		Open Course	4	3	20	80	100
	Total		**25**	**19**			**500**
6	VI	Mathematics Core Course – 9	5	4	20	80	100
		Mathematics Core Course-10	5	4	20	80	100
		Mathematics Core Course-11	6	4	20	80	100
		Mathematics Core Course-12	5	4	20	80	100
		Choice Based Course	4	3	20	80	100
		Project	0	2	20	80	100
	Total		**25**	**21**			**600**

PROGRAMME AND PROGRAMME SPECIFIC OUTCOME

PROGRAMME OUTCOME

PO No.	Upon completion of undergraduate programme, the students:
PO-1	Understand the discipline at both theoretical and application levels
PO-2	Achieve an aim to expand their studies in the discipline at higher level.
PO-3	Work as a team with enhanced communication and coordination skills
PO-4	Attain skills for employment in their programme related professions.
PO-5	Acquire awareness on socio-cultural and environmental issues.
PO-6	Develop entrepreneurship and leadership abilities.
PO-7	Inculcate a sense of ethics, discipline, time management, emotional intelligence and self-awareness
PO-8	Expand the mindset to pursue lifelong learning.

PROGRAMME SPECIFIC OUTCOME

PSO No.	Upon completion of B.Sc. Mathematics programme, the students:	PO No.
PSO-1	Acquire a comprehensive knowledge and understanding of the fundamental concepts and theories of mathematics.	**1, 2, 8**
PSO-2	Become skillful in logical thinking, problem solving and reasoning.	**1, 2, 8**
PSO-3	Learn mathematics as a tool for analysing various scientific and physical problems	**1, 2, 4**
PSO-4	Gain a thorough understanding of the fundamentals of statistical methods and techniques	**1, 2, 4**
PSO-5	Acquire awareness on environmental issues and human rights.	**5**
PSO-6	Develop analytical skills via group projects, seminar presentation and viva voce sessions	**3, 6, 7**
PSO-7	Develop a sense of inquiry and capability for asking relevant/ appropriate questions, problematizing, synthesising and articulating through research projects.	**3, 7**
PSO-8	Accrue mathematical aptitude to qualify competitive examinations and to pursue higher studies in Mathematics and related fields.	**1, 2, 8**
PSO-9	Attain skills for employment in their programme related professions.	**4**
PSO-10	Recognize the need of self-learning and life-long learning	**1, 2, 8**

DETAILED SYLLABUS OF B.Sc. MATHEMATICS PROGRAMME

MATHEMATICS CORE COURSES

Semester	Title of the Course	Number of hours	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
I	UG21MT1CR01: Foundation of Mathematics	4	3	72	3 hrs	20	80
II	UG21MT2CR01: Analytic Geometry, Trigonometry And Partial Differentiation	4	3	72	3 hrs	20	80
III	UG21MT3CR01: Calculus	5	4	90	3 hrs	20	80
IV	UG21MT4CR01: Vector Calculus, Theory of Equations and Numerical Methods	5	4	90	3 hrs	20	80
V	UG21MT5CR01: Mathematical Analysis	6	4	108	3 hrs	20	80
	UG21MT5CR02: Differential Equations	6	4	108	3 hrs	20	80
	UG21MT5CR03: Abstract Algebra	5	4	90	3 hrs	20	80
	UG21MT5CR04: Human Rights and Environmental Mathematics	4	4	72	3 hrs	20	80
	Open course	4	3	72	3 hrs	20	80
VI	UG21MT6CR01: Real Analysis	5	4	90	3 hrs	20	80
	UG21MT6CR02: Complex Analysis	5	4	90	3 hrs	20	80
	UG21MT6CR03: Discrete Mathematics	6	4	108	3 hrs	20	80
	UG21MT6CR04: Linear Algebra And Metric Spaces	5	4	90	3 hrs	20	80
	Choice Based Course	4	3	72	3 hrs	20	80
	UG21MT6PV: Project	0	2	0	-	20	80

Open Course for students of other/own departments during the Fifth Semester

Code	Title of the Course	No. of contact hrs/week	No. of Credit	Duration of Exam
UG21MT5OC01	Applicable Mathematics	4	4	3 hrs
UG21MT5OC02	Financial Mathematics	4	4	3 hrs
UG21MT5OC03	Mathematical Economics	4	4	3 hrs
UG21MT5OC04	Mathematical Modeling	4	4	3 hrs

Choice Based Course for students of our own department during the Sixth Semester

Code	Title of the Course	No. of contact hrs/week	No. of Credit	Duration of Exam
UG21MT6CB01	Operations Research	4	3	3 hrs
UG21MT6CB02	Topology	4	3	3 hrs
UG21MT6CB03	Fuzzy Mathematics	4	3	3 hrs
UG21MT6CB04	History of Indian Mathematics	4	3	3 hrs

Projects :

All students are to do a project in the area of core course. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the Controller of Examinations. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

COMPLEMENTARY COURSES:

1. Mathematics for B.Sc Physics / Chemistry

Semester	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
1	UG21MT1CM01: Partial Differentiation, Matrices, Trigonometry and	4	3	72	3 hrs	20	80
2	UG21MT2CM01: Integral Calculus and Differential	4	3	72	3 hrs	20	80
3	UG21MT3CM01: Vectors, Analytic Geometry and Abstract Algebra	5	4	90	3 hrs	20	80
4	UG21MT4CM01: Fourier Series , Integral Transforms, and Linear Algebra	5	4	90	3 hrs	20	80

2. Mathematics for B.Sc Statistics

Semester	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
1	**UG21MT1CM02: Differential Calculus, Logic And Boolean algebra**	4	3	72	3 hrs	20	80
2	**UG21MT2CM02: Integral Calculus And Trignometry**	4	3	72	3 hrs	20	80
3	**UG21MT3CM02: Vector Calculus, Differential equations And Laplace Transform**	5	4	90	3 hrs	20	80
4	**UG21MT4CM02: Linear Algebra, Theory of Equations, Numerical Methods and Special functions**	5	4	90	3 hrs	20	80

English:

Semester	Title of the Course	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
1	English I	5	4	90	3 hrs	20	80
	English /Common course I	4	3	72	3 hrs	20	80
2	English II	5	4	90	3 hrs	20	80
	English /Common course II	4	3	72	3 hrs	20	80
3	English III	5	4	90	3 hrs	20	80
4	English – IV	5	4	90	3 hrs	20	80

Second Language:

Semester	Title of the Course	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
1	Second Language I	4	4	72	3 hrs	20	80
2	Second Language II	4	4	72	3 hrs	20	80
3	Sec. Lang./ Common course I	5	4	90	3 hrs	20	80
4	Sec. Lang./ Common course II	5	4	90	3 hrs	20	80

SEMESTER ONE

MATHEMATICS (CORE COURSE)

Semester I	Code: UG21MT1CR01	FOUNDATIONS OF MATHEMATICS	Total Hrs:**72**	Credits: **4**
			Hrs/Week:**4**	

Course Objective

- Introduce basic logic
- Explain the fundamental ideas of sets, functions and relations
- Introduce matrices

Syllabus

Module I : LOGIC (20 hrs)

Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Rules of Inference, Introduction to Proofs.
Text 1. Chapter 1 (Sections 1.4 and 1.7 are excluded)

Module II :SETS AND FUNCTIONS (12 hrs)

Sets, Set operations, Functions, Sequences and summations
Text 1. Chapter 2

Module III : RELATIONS (20 hrs)

Relation and Their Properties, Representing Relation, Equivalence Relations and Partial Orderings
Text 1. Chapter 7 (Sections 7.2 and 7.4 are excluded)

Module IV : MATRICES (20 hrs)

Definitions and examples of Symmetric, Skew-symmetric, Conjugate, Hermitian, Skew-hermitian matrices. Rank of Matrix , Determination of rank by Row Canonical form and Normal form , Linear Equations, Solution of non homogenous equations using Augmented matrix and by Cramers Rule , Homogenous Equations, Characteristic Equation , Characteristic roots and Characteristic vectors of matix , Cayley Hamilton theorem and applications.

Text 2. Relevant Sections of Chapters 2, 5, 10, 19 and 23 (Proofs of all Theorems in Module IV are Excluded)

Text Books:

1. K.H.Rosen : Discrete Mathematics And Its Applications (6th Edition) ,

   Tata McGraw-Hill Publishing Company Limited New Delhi
2. Frank Ayres Jr : Matrices , Schaum's Outline Series , TMH Edition.

References:

1. Clifford Stien, Robert L Drysdale, KennethBogart ; Discrete Mathematics for Computer Scientists; Pearson Education; Dorling Kindersley India Pvt. Ltd
2. Kenneth A Ross; Charles R.B. Wright ; Discrete Mathematics; Pearson Education; Dorling Kindersley India Pvt. Ltd
3. Ralph P. Grimaldi, B.V.Ramana; Discrete And Combinatorial Mathematics ; Pearson Education; Dorling Kindersley India Pvt. Ltd
4. Shanti Narayan: Matrices , S Chand & Company
5. Lipschutz: Set Theory And Related Topics (2ndEdition), SchaumOutlineSeries, Tata McGraw-Hill Publishing Company, New Delhi

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	1	**6**
II	3	2	0	**5**
III	3	2	1	**6**
IV	3	3	2	**8**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Explain logical expressions and understand proofs as formal logical process.	K2
2	Construct simple proofs.	K3, K5
3	Describe basic mathematical objects such as sets, functions and relations.	K1
4	Use computational and algebraic skills to calculate rank, eigen values and eigen vectors of a matrix.	K3, K5
5	Solve simultaneous linear equations using matrices.	K3, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)

Semester I	Code: UG21MT1CM01	PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND NUMERICAL METHODS	Total Hrs:**72** Hrs/Week:**4**	Credits: **3**

Course Objective

- Introduce Partial Differentiation
- Better understanding of matrices and matrix algebra
- Introducing numerical techniques for solving real life problems
- Apply and prove trigonometric identities

Syllabus

Module I: Partial Differentiation (12 hrs)

Functions of several variables (Definitions only), Partial derivatives, The Chain Rule

Text 1 Chapter 14 (Sections 14.1(Definitions only) , 14.3 and 14.4)

Module II: Matrices (23hrs)

Definitions and examples of Symmetric, Skew-symmetric, Conjugate, Hermitian, Skew-Hermitian matrices, Rank of Matrix , Determination of rank by Row Canonical form and Normal form , Linear Equations, Solution of non homogenous equations using Augmented matrix and by Cramers Rule , Homogenous Equations, Characteristic Equation , Characteristic roots and Characteristic vectors of matices, Cayley Hamilton theorem and applications.

Text 2 Relevant Sections of Chapters 2, 5 , 10 , 19 and 23 (Proofs of all Theorems in Module II are Excluded)

Module III: Trigonometry (23hrs)

Expansions of $\sin n\theta, \cos n\theta$, $\tan n\theta$, $\sin^n\theta$, $\cos^n\theta, \sin^n\theta\cos^m\theta$ Circular and hyperbolic functions, inverse circular and hyperbolic function. Separation into real and imaginary parts. Summation of infinite series based on C + iS method.

Text 3 (Relevant Sections of Chapters 3 to 5 and 8)

Module 1V: Numerical Methods(14 Hrs)

Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method

Text 4 Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4 and 2.5)

Text Books:

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. Frank Ayres Jr : Matrices, Schaum's Outline Series, TMH Edition.
3. S.L. Loney – Plane Trigonometry Part – II, AITBS Publishers India, 2009.
4. S.S .Sastry : Introductory methods of Numerical Analysis ,4^{th} edition (Prentice Hall)

References:

1. Shanti Narayan : Differential Calculus (S Chand)
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.
3. S.S. Sastry, Engineering Mathematics, Volume 1, 4^{th} Edition PHI.
4. Muray R Spiegel, Advanced Calculus, Schaum's Outline series.
5. Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	0	**6**
II	3	2	2	**7**
III	4	2	1	**7**
IV	2	2	1	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Describe the concept of partial differentiation and learn to find the partial derivatives.	K1,K2
2	Use computational and algebraic skills to calculate rank, eigen values and eigen vectors of a matrix.	K3, K5
3	construct and solve algebraic equations using numerical techniques	K3, K5,K6
4	Apply and construct proofs for trigonometric identities	K3, K5,K6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO STATISTICS)

Semester I	Code: UG21MT1CM02	DIFFERENTIAL CALCULUS, LOGIC AND BOOLEAN ALGEBRA	Total Hrs: **72**	Credits: **3**
			Hrs/Week: **4**	

Course Objective

- Explain the fundamental ideas of differential calculus and its application
- Introduce partial derivative
- Introduce basic logic

Syllabus

Module I: Differential Calculus (22 hrs)

Rates of change and limits, calculating limits using the limit laws, the precise definition of a limit, one sided limits and limits at infinity**,** derivative of a function, differentiation rules, the derivative as a rate of change, derivatives of trigonometric functions, the chain rule and parametric equations, implicit differentiation.

Text 1 Sections 2.1 – 2.4, 3.1 – 3.6

Module II: Application of derivatives (15 hrs)

Extreme values of functions, The Mean Value Theorem, Monotonic functions and the first derivative test.

Text 1 Sections 4.1 - 4.3

Module III: Partial Derivatives (15 hrs)

Functions of several variables (Definition only), Partial derivatives, The Chain Rule

Text 1 Sections 14.3 - 14.4

Module 1V: Logic and Boolean Algebra (20 hrs)

Proposition, compound propositions, basic logical operations, Propositions and truth tables, Logical equivalence, Algebra of propositions, Conditional and biconditional, Arguments, Propositional functions, Quantifiers

Text 2 sections 4.1 to 4.12

Boolean Algebra: Definitions, theorems, duality, switching circuit

Text 2 sections 15.1, 15.2, 15.3, 15.4, 15.10

Text Books:

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. Schaum's outline series - Discrete mathematics, second edition

References:

1. Shanty Narayan : Differential Calculus (S Chan)
2. S.S. Sastry, Engineering Mathematics, Volume 1, 4^{th} Edition PHI.
3. Murray R Spiegel, Advanced Calculus, Schaum's Outline series
4. Robert.R.Stoll-Set theory And Logic (Eurasia Publishers,N.Delhi)
5. B.S.Vatssa-Discrete Mathematics-Third edition

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	1	**7**
II	3	2	1	**6**
III	3	2	1	**6**
IV	3	2	1	**6**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Express and evaluate the different ideas in differential calculus	K2, K4, K5
2	Memorize and apply the important theorems of differential calculus	K1, K3
3	Define and evaluate the different partial derivatives of multivariable functions	K1, K2

4	Illustrate the importance of different logical operations	K2, K3
5	Construct truth tables and switching circuits	K3, K6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination, online test and assignments

SEMESTER TWO

MATHEMATICS (CORE COURSE)

Semester II	Code: UG21MT2CR01	ANALYTIC GEOMETRY, TRIGONOMETRY AND PARTIAL DIFFERENTIATION	Total Hrs:**72**	Credits: 4
			Hrs/Week:**4**	

Course Objective

- Better understanding of Conic Sections
- Introduce Polar form of Conic Sections
- Apply and prove trigonometric identities
- Introduce Partial Differentiation

Syllabus

Module I Conic Sections(Cartesian And Parametric) **(22hrs)**

Tangent and Normals, Orthoptic Locus, Parametric Equations of Tangents and Normals, Chords in terms of given points, Pole And Polar and Conjugate diameters of Ellipse.
Relevant Sections of Text 1

Module II Polar Co-ordinate (15 hrs)

Polar Co-ordinates, Polar Equation of line , Polar Equation of Circles, Polar Equation of Conic, Chords of Conic Sections.
Relevant Sections of Text 1

Module III Trigonometry(17 hrs)

Circular And Hyperbolic functions of complex variables, Separation of functions of complex variables into real and imaginary parts, Factorisation of x^n-1 , x^n+1 , $x^{2n}-2x^na^n\cos n\theta+a^{2n}$, and Summation of infinite Series by C+iS method
Relevant Sections of Text 2 Chapters V , VII , IX.

Module IV: Partial Differentiation (18hrs)

Partial derivatives, The chain rule., Extreme values and saddle points, Lagrange multipliers.

Text 3 Chapter 14 (Sections 14.3 , 14.4, 14.7 and 14.8 only. All other sections are excluded)

Text Books:

1. Manicavachagom Pillay, Natarajan : Analytic Geometry (Part I Two Dimensions)
2. S.L.Loney :Plane Trigonometry Part II , S.Chand and Company Ltd
3. George B Thomas Jr: Thomas' Calculus (11th Edition) , Pearson

References:

1. S.K. Stein : Calculus And Analytic Geometry, McGraw Hill
2. P.K. Jain , Khalil Ahmad : Analytic Geometry of Two Dimensions,(2nd Edition) New Age International (P) Limited Publishers
3. Thomas and Finney : Calculus and Analytic Geometry , Addison Wesley

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	4	2	1	**7**
II	2	2	1	**5**
III	3	3	1	**7**
IV	3	2	1	**6**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Visualize and identify a conic as sections of a cone	K1, K2
2	construct geometric objects like tangents and normals related to different conic sections	K3, K6
3	Discover the polar equations f different conic sections	K2, K3
4	Express the circular and hyperbolic functions of a complex variable and determine the sum of infinite series using C+iS method.	K2, K3
5	Explain the basic concepts of partial derivatives.	K2, K3, K4
6	Determine and analyse stationary points to find the extreme values	K3, K4
7	Solve the multi constraint extreme value problems using Lagrange multipliers	K3, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Assessment Tools

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)

Semester **II**	Code: **UG21MT2CM01**	**INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS**	Total Hrs:**72**	Credits: **3**
			Hrs/Week:**4**	

Course Objective

- Introducing the technique of integration in geometrical measures.
- Skillfully use of multiple integrals
- Introduce Ordinary and Partial differential equations.

Syllabus

Module I: Integral Calculus (15 hrs.)

Substitution and area between curves, Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution and the theorem of Pappus (excluding theorem of Pappus)
(Section 5.6, 6.1, 6.3, 6.5 of Text - 1)
Text 1: Chapter 5 (Section 5.6) Chapter 6 (Sections 6.1, 6.3, 6.5)

Module II: Multiple Integrals (17 hrs)

Double Integrals, area of bounded region in plane only, Double Integrals in Polar form, Triple integrals in rectangular co-ordinates, Volume of a region in space.
Text 1: Chapter 15 (Sections 15.1, 15.2, 15.3, 15.4)

Module III: Ordinary differential equations (20 Hrs)

Separable Variables , Exact Differential Equation, Equations reducible to exact form, Linear Equations , Solutions by Substitutions, Homogeneous equations and Bernoulli's Equations

Text 2: Chapter 2

Module IV:Partial Differential Equations (20 Hrs)

Surfaces and Curves in three dimensions, solution of equation of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$. Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method

Text 3: Chapter 1 (Sections 1 and 3) Chapter 2 (Sections 1, 2 and 4)

Text Books:

1. George B. Thomas, Jr: Thomas' Calculus 11th Edition,(Pearson).
2. A. H Siddiqi , P Manchanada : A first Course in Differential Equations with Applications (Macmillan India Ltd 2006)
3. Ian Sneddon – Elements of Partial Differential Equation (Tata McGraw Hill)

References:

1. Shanti Narayan , P .K . Mittal :Integral Calculus (S. Chand & Company)
2. Differential Equations E. Rukmangadachari; Pearson
3. R. K. Ghosh, K. C. Maity – An Introduction to Differential Equations, New Central Books

QUESTON PAPER PATTERN

Module	**Part A 2 Mark**	**Part B 5 Marks**	**Part C 15 Marks**	**Total**
I	3	2	1	**6**
II	3	3	1	**7**
III	3	2	1	**6**
IV	3	2	1	**6**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	**Upon completion of this course, the students will be able to:**	**Knowledge Level**
1	Define and associate various geometric measures to integrals.	K1, K2
2	Construct and evaluate multiple integrals	K3, K4, K5, K6
3	Categorise differential equations and use the best techniques to solve them.	K3, K4, K6
4	Formulate partial differential equations using two different methods	K6
5	Solve lagranges partial differential equations	K3, K6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO STATISTICS)

<table>
<tr><td rowspan="2">Semester
II</td><td rowspan="2">Code:
UG21MT2CM02</td><td rowspan="2">**INTEGRAL CALCULUS AND TRIGONOMETRY**</td><td>Total Hrs:**72**</td><td rowspan="2">Credits:
3</td></tr>
<tr><td>Hrs/Week:**4**</td></tr>
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Course Objective

- Identify the relation between integration and summation
- Apply integration to find area and volume.
- Discuss the various Techniques of integration.
- Better understanding of trigonometric identities

Syllabus

Module I : Integral Calculus(15 hrs)
Sigma notation and limit of finite sums, The Definite integral. The fundamental theorem of Calculus. Indefinite integration and substitution rules, Substitution and area between curves.
(Section 5.2, 5.3, 5.4, 5.5 and 5.6 of Text -1).

Module II Application of Integrals (20hrs)
Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution (the theorem of Pappus excluded).
(Section 6.1, 6.3, 6.5 of Text - 1)

Module III Techniques of Integration (17 hrs)
Basic integration formulas, Integration by parts, Integration of rational functions by partial fractions, Trigonometric integrals, and Trigonometric substitutions.
Text – 1 Sections.8.1, 8.2, 8.3, 8.4, and 8.5

Module IV Trigonometry (20hrs)
Complex quantities, Demoiver's theorem(without proof), Circular and hyperbolic functions, inverse circular and hyperbolic function. Separation into real and imaginary parts, Summation of infinite series based on C + iS method. (Geometric, Binomial, Exponential, Logarithmic and Trigonometric series)
(Relevant Sections in Chapter 2, 5 and Chapter 8 of Text 2)

Text Books:

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. S.L. Loney – Plane Trigonometry Part – II, AITBS Publishers India, 2009.

References:

1. George B. Thomas Jr. and Ross L. Finney : Calculus and Analytic Geometry, LPE, Ninth edition, Pearson Education
2. Shanti Narayan , P .K . Mittal :Integral Calculus (S. Chand & Company.
3. S.S. Sastry, Engineering Mathematics, Volume 1, 4^{th} Edition PHI.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	1	**6**
II	2	2	1	**5**
III	3	3	1	**6**
IV	4	2	1	**8**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Recall and apply the fundamental theorem of calculus.	K1, K3
2	Define definite integrals and evaluate them.	K1, K4, K5
3	Associate various geometric measures to integrals and eventually construct and evaluate them	K2, K4, K5, K6
4	Employ different integration techniques	K3
5	Calculate the sum of infinite series using trigonometric identities.	K3, K4
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

SEMESTER THREE

MATHEMATICS (CORE COURSE)

Semester **III**	Code: **UG21MT3CR01**	**CALCULUS**	Total Hrs:**90** Hrs/Week:**5**	Credits: **4**

Course Objective

- Better understanding of Differential calculus
- Apply differential calculus in geometry.
- Introducing the technique of integration in geometrical measures.
- Skillfully use multiple integrals

Syllabus

Module I: Differential Calculus (20 hrs)

Successive Differentiation and Indeterminate forms

Text 1 : Chapter 5 and Chapter 10

Module II: Differential Calculus (30 hrs)

Expansion of functions using Maclaurin's theorem and Taylor's theorem. Concavity and points of inflexion. Curvature and Evolutes. Length of arc as a function derivatives of arc, radius of curvature – Cartesian equations only. (Parametric, Polar, Pedal equation and Newtonian Method are excluded) Centre of curvature, Evolutes and Involutes, properties of evolutes. Asymptotes and Envelopes.

Text 1 : Chapter 6, Chapter 13, Chapter 14 , Chapter 15 (Section 15.1 to 15.4 only), Chapter 18 (Section 18.1 to 18.8 only).

Module III: Integral Calculus (20 hrs.)

Volumes by Slicing and rotation about an axis. Volumes by cylindrical shells, Lengths of Plane Curves, Areas of surfaces of Revolution and the theorems of Pappus.

Text 2: Chapter 6 (Section 6.1, 6.2, 6.3, 6.5)

Module IV: Multiple Integrals (20 hrs)

Double integrals, Areas, Double integrals in polar form, Triple integrals in rectangular coordinates, Triple integrals in cylindrical and spherical coordinates, substitutions in multiple integrals.

Text 2: Chapter 15 (Section 15.1, 15.2 (area only) 15.3, 15.4, 15.6 ,15.7)

Text Books:

1. Shanti Narayan , P.K.Mittal : Differential Calculus, S.Chand and Company.
2. George B Thomas Jr. Thomas' Calculus (11thEdition), Pearson.

References:

1. T. M. Apostol – Calculus Volume I & II (Wiley India)
2. David Widder – Advanced Calculus, 2nd edition
3. K. C. Maity & R. K. Ghosh – Differential Calculus (New Central Books Agency)
4. K. C. Maity & R. K. Ghosh – Integral Calculus (New Central Books Agency)
5. Shanti Narayan, P.K. Mittal - Integral Calculus – (S. Chand & Co.)
6. Howard Anton: Calculus, Wiley.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	1	**6**
II	4	2	1	**7**
III	3	3	1	**7**
IV	2	2	1	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Administer advanced integration and differentiation techniques	K3
2	State Leibnitz Theorem and use it to calculate higher order derivatives of functions and product of functions using	K1, K3, K4
3	Visualize and describe the concept of integration	K1, K2

4	Associate various geometric measures to integrals and eventually construct and evaluate them	K2, K4, K5, K6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)

Semester **III**	Code: **UG21MT3CM01**	**VECTORS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA**	Total Hrs: **90** Hrs/Week: **5**	Credits: **4**

Course Objective

- Skillfully use vectors in Science
- Identify various forms of Conic sections
- Introduce the fundamentals in Abstract algebra

Syllabus

Module I: Vector valued Functions (15 hrs)

Vector Functions, Arc length and unit Tangent vector **T**, Curvature and unit Normal Vector **N**, Torsion and unit Binormal vector **B,** Directional Derivatives and Gradient Vectors**.**
Text 1: Chapter 13 (Sections 13.1, 13.3 and 13.4), Chapter 14 (Section 14.5 only)

Module II: Integration in Vector Fields (30hrs)

Line Integrals, Vector fields and Work, Circulation and Flux, Path independence, Potential Function and Conservation Fields, Green's theorem in Plane (Statement and problems only), Surface area and Surface integral, Parameterised Surface, Stoke's theorem(Statement and Problems only), the Divergence theorem and a Unified theory (Statement and simple problems only).
Text 1: Chapter 16 (Sections 16.1 to 16.8)

Module III : Analytic Geometry (25 hrs)

Conic sections and Quadratic equations, Classifying Conic Sections by Eccentricity, polar co-ordinates, Conic Sections in Polar coordinates.
Text 1: Chapter 10 (Sections 10.1, 10.2, 10.5, 10.8)

Module IV: Abstract algebra (20 hrs)

Groups, Subgroups, Cyclic groups, Groups of Permutations, Homomorphism, Rings and Fields (Definitions and simple examples only)
Text 2: Chapter 1 Sections 4, 5 and 6 (Proofs of theorems 5.17, 6.3, 6.6, 6.7, 6.10, 6.14 are excluded)
Chapter 2. Section 8 (Proofs of theorems 8.5, 8.15 and 8.16 are excluded)

Chapter 3. Sections 13.1, 13.2 and 13.3 only
Chapter 4. Section 18.1 to 18.8 and 18.14 to 18.18 only

Text Books:

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson,
2. John B Fraleigh – A First course in Abstract Algebra (Seventh Edition)

References:

1. Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6^{th} ed., Universal Book Stall, New Delhi.
2. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.
3. I.N Herstein - Topics in Algebra
4. Joseph A Gallian - A Contemporary Abstract Algebra, Narosa Pub. House.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	1	**6**
II	3	3	1	**7**
III	3	2	1	**6**
IV	3	2	1	**6**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Define ,evaluate and express various concepts in vector calculus	K1, K4, K5, K6
2	State and validate the important theorems in vector calculus	K1, K6
3	Evaluate the concepts like work,circulation and determine conservative fields by constructing its potential function.	K3, K4, K5, K6

4	Classify conic sections and determine them in polar coordinates	K2, K3
5	Define and explain the basic concepts of abstract algebra	K1, K3, K4
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO STATISTICS)

Semester III	Code: UG21MT3CM02	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	Total Hrs:**90**	Credits: **4**
			Hrs/Week:**5**	

Course Objective

- Better understanding of vector differential calculus
- Demonstrates ordinary and partial differential equations
- Evaluate Laplace transforms

Syllabus

Module I: Vector Differential Calculus (25 hrs)

A quick Review of vector algebra, Inner product and vector product in R^2 and R^3. Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

Text 1 Sections 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.9, 8.10, 8.11.

Module II: Ordinary differential equations of first order (30 Hrs)

Introduction to Differential Equations , solutions of First order differential equations, variable separable, homogeneous equations, Equations reducible to homogeneous, Linear differential equations, Bernoulli's equations Exact equations(theorem 11.11 statement only),equations reducible to Exact form.

Text 2: Chapter 11- Sections 11.1,11.4, 11.5,11.6,11.7,11.8,11.9, 11.10,11.11,11.12.

Module III: Partial differential equations (20 Hrs)

Introduction ,Formation of partial differential equations,Linear partial differential equations of the first order,Lagrange's equation, and its working method.

Text 2: Chapter 16- Sections 16.1, 16.2, 16.5, 16.6 and 16.7

Module IV: Laplace Transform (15 Hrs)

Introduction, Definition, Linearity Property, Laplace transform of some elementary functions, Shifting Theorems and The Inverse Laplace Transform.

Text 2: Chapter 18 – Section 18.1,18.2, 18.3,18.4,18.5 and 18.6

Text Books:

1. Erwin Kreyszig- Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. N.P.Bali, Dr.N.C.Narayana Iyengar -A text book of engineering mathematics, Laxmipublications(p) Ltd.

References:

1. Shanti Narayan , P .K . Mittal :Vector Calculus (S. Chand & Company)
2. Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6^{th} ed., Universal Book Stall, New Delhi.
3. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.
4. Murray R Spiegel : Differential Equations (Macmillan)

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	4	3	1	**8**
II	4	3	1	**8**
III	2	2	1	**5**
IV	2	1	1	**4**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Define, evaluate and express various concepts in vector calculus	K1, K4, K5, K6
2	Categorise differential equations and use the best techniques to solve them.	K3, K4, K6
3	Formulate partial differential equations using two	K6

	different methods	
4	Solve Lagrange's partial differential equations	K3, K6
5	Explain the concept of Laplace transforms and evaluate both Laplace and inverse Laplace transforms	K2, K3, K4, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

SEMESTER FOUR

MATHEMATICS (CORE COURSE)

Semester IV	Code: UG21MT4CR01	VECTOR CALCULUS, THEORY OF EQUATIONS AND NUMERICAL METHODS	Total Hrs: **90**	Credits: 4
			Hrs/Week: **5**	

Course Objective

- Introduce different forms of vector equations of lines and planes
- Evaluation of integrals in vector field.
- Good understanding of algebraic equations and their solutions
- Apply numerical methods to solve equations.

Syllabus

Module I : A quick review (20 hrs)

Lines and planes in space., Cylinders and Quadric surfaces, Vector functions Arc length and Unit tangent vector, Curvature and Unit normal vector, torsion and Unit Binormal vector, Directional derivatives and gradient vectors , tangent planes and Differentials

Text 1 : Chapter 12 (Sections 12.5 ,12.6 only) ,Chapter 13 (Sections 13.1 , 13.3 , 13.4 , 13.5 only), Chapter 14 (Sections 14.5 , 14.6 only)

Module II : Integration in Vector Fields (30 hrs)

Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields, Green's theorem in the plane, Surface area and surface integrals, Parameterized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

Text 1: Chapter 16 (Sections 16.1 to 16.8)

Module III: Theory of Equations (25 hrs)

Statement of fundamental Theorem of algebra. Deduction that every polynomial of degree n has n and only n roots. Relation between roots and coefficients. Transformation of equations. Reciprocal equations. Cardan’s method, Ferrari’s method. Symmetric functions of roots.

Text 2: Chapter 2 (Sections 2.1 to 2.14; 2.16 to 2.18; 2.20; 2.21)

Module IV: Introductory Methods of Numerical Solutions (15 hrs)

Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method

Text 3: Chapter 2 (Sections 2.2, 2.3, 2.4, 2.5 only)

Text Books:

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.
2. N.P. Bali, Dr. N. Ch. NarayanaIyengar.- Text book on Engineering mathematics, Laxmi publications
3. S.S. Sastry - Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

References:

1. Erwin Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.
2. Shanti Narayan, P.K Mittal – Vector Calculus (S. Chand)
3. Merle C. Potter, J. L. Goldberg, E. F. Aboufadel – Advanced Engineering Mathematics (Oxford)
4. QuaziShoebAhamad - Numerical and Statistical Techniques (Ane Books)

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	4	2	0	**6**
II	4	2	2	**8**
III	3	3	1	**7**
IV	1	2	1	**4**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Define and describe various concepts of vector calculus like tangent vector, curvature ,binormal vector .	K1, K2
2	Evaluate the Integral of functions of several variables over curves and surfaces	K4, K5
3	State and Administer Green’s theorem , Divergence theorem to evaluate integrals	K1, K3, K5
	like Cardon’s and Ferrari’s methods	
5	Solve algebraic and transcendental equations using numerical methods	K3, K6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Assessment Tools

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Learning Pedagogy

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)

Semester **IV**	Code: **UG21MT4CM01**	**FOURIER SERIES, LAPLACE TRANSFORM AND LINEAR ALGEBRA**	Total Hrs:**90**	Credits: **4**
			Hrs/Week:**5**	

Course Objective

- Exhibit Fourier series expansion of various functions
- Introduce Laplace Transformation of functions
- Better understanding of matrices and linear transforms.

Syllabus

Module I: Fourier Series and Legendre Polynomials (25 hrs)

Periodic Functions, Trigonometric Series, Fourier Series, Functions of any period p = 2L, Even and Odd functions-Half-range Expansions.

A brief introduction to power series and power series method solving Differential equations. Legendre equation and Legendre Polynomials$P_n(x)$.

Text 1 (Sections 10.1, 10.2, 10.3, 10.4 and 4.1, 4.3)

Module II: Laplace Transforms (25 hrs)

Laplace Transform - Inverse Laplace Transform – Linearity - Shifting, Transforms of Derivatives and Integrals - Differential equations, Differentiation and Integration of Transforms, Laplace Transform: General formula (relevant formulae only), Table of Laplace Transforms (relevant part only). (proofs of all theorems in this module are excluded)

Text 1 (Sections 5.1, 5.2, 5.4, 5.8 and 5.9)

Module III: Vector Spaces (20 hrs)

Vectors, Subspace, Linear Independence, Basis and Dimension (proofs of theorem 1 in page 123 and theorem 4 in page 125 are excluded), Row Space of a Matrix (proofs of all theorems in this section are excluded), Rank of a Matrix (proofs of all lemmas and theorems in this section are excluded)

Text 2 Chapter 2 (Sections 2.1 to 2.6)

Module IV: Linear transformation (20 hrs)

Functions, Linear Transformations, Matrix Representations, Change of Basis (proofs of all theorems in this section are excluded), Properties of Linear Transformations (proofs of theorem 4 in page 206 and corollary 1 in page 209 are excluded).

Text 2 Chapter 3 (Sections 3.1 to 3.5)

Text Books:

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. Richard Bronson, Gabriel B. Costa - Linear Algebra An Introduction (2nd Edition), Academic Press 2009, an imprint of Elsevier

References:

1. B.S. Grewal - Higher Engineering Mathematics
2. S. Kumaresan - Linear Algebra, A Geometric Approach, Prentice Hall of India, New Delhi,1999
3. Stephen Andrilli, David Hecker - Elementary Linear Algebra, Academic Press.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	1	**6**
II	4	3	1	**8**
III	3	2	1	**6**
IV	2	2	1	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**

Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	**Upon completion of this course, the students will be able to:**	**Knowledge Level**
1	Define and describe Fourier series ,Legendre equations and Legendre polynomials	K1, K2
2	Construct the periodic functions in terms sine and cosine series.	K3, K6
3	Evaluate the Laplace transforms of various functions	K4, K5
4	Recognise the features of vector space through various examples	K1
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

(COMPLEMENTARY COURSE TO STATISTICS)

Semester **IV**	Code: **UG21MT4CM02**	**LINEAR ALGEBRA, THEORY OF EQUATIONS, NUMERICAL METHODS AND SPECIAL FUNCTIONS**	Total Hrs:**90** Hrs/Week:**5**	Credits: **4**

Course Objective

- Introduce different kinds of matrices
- Good understanding of algebraic equations and their solutions
- Apply numerical methods to solve equations.
- Identify Beta and Gamma functions.

Syllabus

Module I: Linear Algebra (35 hrs)

A quick review of the fundamental concepts of matrices, Matrix Multiplication(excluding by linear transformation) Linear system of equations, Rank of a Matrix, Linear dependence and independence of vectors (exluding vector space, dimension and basis),Solution of linear systems, Determinants, Cramer's rule, Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only), Symmetric ,Skew symmetric and orthogonal matrices, Complex matrices, Hermitian,Skew- Hermitian and unitary matrices,(definitions and examples only)
Text 1: Sections 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 7.1, 7.3, 7.4

Module II: Theory of Equations (20 hrs)

Statement of Fundamental theorem of Algebra, Relation between roots and coefficients, Transformation of equations, Reciprocal equations, Descarte's rule of signs and Cardon's method.
Text 2, chapter 2 sections-2.1 to 2.14, 2.17 and 2.18

Module III: Numerical methods (20 hours)

Introduction, Bisection Method, Method of False position, Iteration Method, Newton – Raphson Method.

Text 3: Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4 and 2.5)

Module IV: Special functions (15 hrs)

Beta and Gamma functions, Reduction formula for gamma. Relation between beta and gammafunctions.

Text 2: Chapter 15 sections 15.1, 15.2, 15.3, 15.4, 15.5 and 15.6

Text Books:

1. Erwin Kreyszig - Advanced Engineering Mathematics, 8th Edition, Wiley, India
2. N.P. Bali, Dr. N. Ch. NarayanaIyengar.- Text book on Engineering mathematics, Laxmi publications
3. S.S.Sastry-Introductory Methods of Numerical Analysis,Fourth Edition, PHI

References:

1. Kenneth Hoffman, Ray Kunze-Linear Algebra (second edition) prentice-Hall India.
2. Thunter – An elementary treatise on the Theory of Equations with examples.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	2	**8**
II	3	3	1	**7**
III	3	2	1	**6**
IV	3	1	0	**4**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO	Upon completion of this course, the students will be	Knowledge

No.	able to:	Level
1	Identify and distinguish different types of matrices	K1, K2, K4, K5
2	Solve linear systems using the concept of Rank of a matrices	K3, K6
3	Devise various methods to solve algebraic equations	K3, K6
4	Apply various numerical methods to calculate the roots of algebraic equations	K3, K4
5	Define Beta gamma functions and state the relationship between them	K1
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

SEMESTER FIVE

MATHEMATICS (CORE COURSE)

Semester **V**	Code: **UG21MT5CR01**	**MATHEMATICAL ANALYSIS**	Total Hrs:**108** Hrs/Week:**6**	Credits: **4**

Course Objective

- Describe the fundamental properties of the real numbers that underpin the formal development of real analysis
- Introduce and develop basic analytic concepts of limit, convergence, integration and differentiation.
- Describe the properties of complex numbers and to evaluate the different attributes of complex numbers.
- Apply the theory of Laplace transforms to various differential and integral calculus problems.

Syllabus

Module I (40 hrs)

Intervals. Bounded and unbounded sets, supremum, infimum. Order completeness in R. Archimedian property of real numbers. Dedekinds form of completeness property.

Text 1: Chapter 1 (Sections 2.6, 3, 4.1, 4.2, 4.3, 4.4)

Neighbourhood of a point. Interior point of a set. Open set. Limit point of a set. Bolzano weierstrass theorem for sets. Closed sets, closure of a set. Dense sets. Countable and uncountable sets.

Text 1: Chapter 2 (Sections : 1.1,1.2,1.3, 2, 2.1, 2.2, 3.1, 3.2, 3.3, 3.4, 3.5, 4)

Module II (30 hrs)

Real sequences. The range, bounds of a sequence. Convergence of sequences. Some theorems, limit points of a sequence. Bolzano weierstrass theorem for sequences. Limit interior and superior. Convergent sequences. Cauchy's general principle of convergence. Cauchy's sequences. Algebra of sequences **(Statements of theorem without proof)**. Some important theorems and examples related to them. Monotonic sequences, subsequences.

Text 1: Chapter 3 (Sections : 1.1 to 1.4, 2 to 2.3; 3 ; 4 ; 5; 6, 6.1 ,7, 8, 9, 9.1)

<u>Module III : Complex numbers (20 hrs)</u>

Sums and products. Basic algebraic properties. Further properties. Vectors and moduli. Different representations. Exponential forms. Arguments of products and quotients. Product and powers in exponential form. Roots of complex numbers. Regions in the complex plane.

Text 2: Chapter 1 (Section 1 to 11)

<u>Module IV: Laplace Transforms (18 Hrs)</u>

Laplace Transform, Linearity of Laplace Transform, First- shifting Theorem(s- Shifting), Transforms of derivative and integral of a function, solutions of ordinary differential equations & initial value problems, Convolution, convolution theorem.

Text 2 Chapter 18 (Sections 18.1 to 18.12)

Text Books:

1. S.C.Malik, Savitha Arora - Mathematical analysis. Fourth edition.
2. J.W. Brown and Ruel.V.Churchill - Complex variables and applications, 8th edition. Mc.Graw Hill.
3. N. P Bali and Dr. Manish Goyal,, A Text book of Engineering Mathematics, Eighth Edition Laxmi Publication Limited, New Delhi.

References:

1. Robert G Bartle and Donald R Sherbert –Introduction to real analysis 3rdedition.Wiley
2. Richard R Goldberg – Methods of real analysis 3rd edition , Oxford and IBM Publishing Co (1964)
3. Shanti Narayan – A Course of mathematical analysis , S Chand and Co Ltd(2004)
4. M.R Spiegel – Complex Variables, Schaum's Series
5. Erwin Kreyszig – Advanced Engineering Mathematics, Ninth Edition, Wiley, India.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total

I	4	3	1	**8**
II	3	2	2	**7**
III	3	2	0	**5**
IV	2	2	1	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Define and distinguish the basic properties of field of real numbers.	K1, K2
2	Develop a systematic and rigorous understanding of real valued function of real variable.	K2
3	Analyze and apply theorems in a precise mathematical manner	K4, K3
4	Analyse and understand complex numbers and their properties	K4
5	Evaluate Laplace transform of various functions	K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester V	Code: UG21MT5CR02	DIFFERENTIAL EQUATIONS	Total Hrs: 108	Credits: 4
			Hrs/Week: 6	

Course Objective

- Evaluate first order differential equations including separable, homogeneous, exact, and linear
- Show existence and uniqueness of solutions.
- Solve second order and higher order linear differential equations.
- Obtain power series solution to differential equation.
- Solve partial differential equation

Syllabus

Module I : Ordinary differential equations (25 hrs)

Exact differential equations and integrating factors (proof of theorem 2.1 excluded) , separable equations and equations reducible to this form,, linear equations and Bernoulli equations, special integrating factors and transformations. Orthogonal and oblique trajectories.

Text 1: (Sections 2.1 , 2.2, 2.3 , 2.4, 3.1)

Module II (30 hrs)

Basic theory of linear differential equations. The homogeneous linear equation with constant coefficients. The method of undetermined coefficients, Variation of parameters, The Cauchy – Euler equation.

Text 1: (Section 4.1 , 4.2 , 4.3, 4.4, 4.5)

Module III (33hrs)

Power series solution about an ordinary point, solutions about singular points, the method of Frobenius , Bessel's equation and Bessel Functions, Differential operators and an operator method.

Text 1: (Section 6.1 , 6.2 , 6.3, 7.1)

Method IV : Partial Differential equations(20 hrs)

Surfaces and Curves in three dimensions, solution of equation of the form

$\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$. Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method

Text 2 : Chapter 1 (Section 1 and 3), Chapter 2 (Section 1, 2 and 4)

Text Books:

1. Shepley L. Ross - Differential Equations, 3rd ed., (Wiley India).
2. Ian Sneddon – Elements of Partial Differential Equation (Tata McGraw Hill)

References:

1. A.H.Siddiqi& P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)
2. George. F. Simmons – Differential equation with applications and historical notes (Tata McGrawHill)
3. E.A. Coddington - An Introduction to Ordinary Differential Equation, PHI.
4. Sankara Rao - Introduction to Partial Differential Equation,2nd edition, PHI.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	4	1	**8**
II	4	2	1	**7**
III	2	2	1	**5**
IV	3	1	1	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**

Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand different types of differential equations	K2
2	Obtain an integrating factor which may reduce a given differential equation into an exact one and eventually provide its solution	K2, K5
3	Identify and obtain the solution of Clairaut's equation	K2, K5
4	Find the complementary function and particular integrals of linear differential equation	K5
5	Familiarize the orthogonal trajectory of the system of curves on a given surface	K2
6	Find power series solutions of differential equations	K2, K5
7	Describe the origin of partial differential equation and distinguish the integrals of first order linear partial differential equation into complete, general and singular integrals	K1, K2, K4
8	Use Lagrange's method for solving the first order linear partial differential equation	K3, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester V	Code: **UG21MT5CR03**	**ABSTRACT ALGEBRA**	Total Hrs: **90**	Credits: **4**
			Hrs/Week: **5**	

Course Objective

- Introduce the basic concepts from abstract algebra, especially the notion of group, sub group and some counting principles.
- Understand the importance and application of Cayley's and Lagrange's theorem
- Understand the concepts of homorphism, rings and fileds with a variety of examples.

Syllabus

Module I (25 hrs)

Groups and subgroups-Binary operations, Isomorphic binary structures, Groups-definition and examples, elementary properties of groups, finite groups and group tables, subgroups, cyclic subgroups, cyclic groups, elementary properties of cyclic groups.

Part I : Sections 2, 3, 4, 5 and 6

Module II (20 hrs)

Permutations, cosets, and direct products-groups of permutations, Cayley's theorem, orbits, cycles and the alternating groups, cosets and the theorem of Lagrange, direct products.

Part II: Sections 8, 9, 10, 11.1and 11.2

Module III (25 hrs)

Homomorphisms and Factor groups- Homomorphisms, properties of homomorphisms, factor groups, The Fundamental Homomorphism theorem, normal subgroups and inner automorphisms, simple groups.

Part III: Sections 13, 14, 15.14 to 15.18

Module IV (20 hrs)

Rings and fields-definitions and basic properties, homomorphisms and isomorphisms, Integral domains- divisors of zero and cancellation, integral domains, The characteristic of a ring.
Part IV: Sections 18 and 19

Text Books:

1. A First Course in Abstract Algebra (7^{th} Edition) John B. Fraleigh (Pearson)

References:

1. I.N Herstein - Topics in Algebra
2. Joseph A Gallian - A Contemporary Abstract Algebra,NarosaPub. House.
3. Artin – Algebra , PHI

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	1	**7**
II	4	2	1	**7**
III	2	2	1	**5**
IV	3	2	1	**6**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Have a thorough knowledge and familiarity of important mathematical concepts in abstract algebra.	K2
2	Form a group structure from a given set.	K6
3	Develop and analyze different types of subgroups such as normal subgroups, cyclic subgroups permutation groups, and factor groups .	K5 ,K6
4	Distinguish the concepts of rings and fields and understand their properties.	K2,K4
5	Gain a clear knowledge of the concepts of homomorphism's, isomorphisms and their properties.	K2, K3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester **V**	Code: **UG21MT5CR04**	**HUMAN RIGHTS AND ENVIORNMENTAL MATHEMATICS**	Total Hrs:**72**	Credits: **4**
			Hrs/Week:**4**	

Course Objective

- Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental issues. By developing and enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.
- Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future, encourage character building, and develop positive attitudes and values.
- To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment for protecting the nature and natural resources.
- To help the students in acquiring the basic knowledge about environment and to inform the students about the social norms that provide unity with environmental characteristics and create positive attitude about the environment.

Syllabus

<u>Module I: Environment and its resources (10 hours)</u>

Multidisciplinary nature of environmental studies:

Definition, scope and importance

Need for public awareness.

Natural Resources :

Renewable and non-renewable resources : Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies.
   Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.
f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification

Role of individual in conservation of natural resources.

Equitable use of resources for sustainable life styles.

(Text 1- unit 1- sections 1.1,1.2,unit 2-sections 2.1,2.2,2.3,2.4)

<u>ModuleII: Environmental Pollution and Social Issues (14 hours)</u>

Pollution- Definition,Causes, effects and control measures of:

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution

Disaster management: floods, earthquake, cyclone and landslides.

(Text 1. -unit 5-sections 5.1, 5.2, 5.3, 5.4, 5.6)

Social Issues and the Environment:

Urban problems related to energy

Water conservation, rain water harvesting, watershed management

Resettlement and rehabilitation of people: its problems and concerns, Case studies

Environmental ethics: Issues and possible solutions

Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and Holocaust, Case studies

Consumerism and waste products

Public awareness

(Text 1. Unit 6--sections 6.1, 6.2, 6 .4, 6.5, 6.6, 6.15)

<u>Module III : Fibonacci Numbers in nature (15 hours)</u>

The rabbit problem:

The rabbit problem, Fibonacci numbers, recursive definition, Lucas numbers, Different types of Fibonacci and Lucas numbers.

Fibonacci numbers in nature :

Fibonacci and the earth, Fibonacci and flowers, Fibonacci and sunflower, Fibonacci, pinecones, artichokes and pineapples, Fibonacci and bees, Fibonacci and subsets, Fibonacci and sewage treatment, Fibonacci and atoms, Fibonacci and reflections, Fibonacci, paraffins and cycloparaffins, Fibonacci and music, Fibonacci and compositions with 1's and 2's

The Eucledean Algorithm:

The Eucledean Algorithm and Lucas Formula

Text 2 : Chapters 2 & 3 (excluding Fibonacci and poetry, Fibonacci and electrical networks), Chapters 9.

<u>Module IV : Golden Ratio (15 hours)</u>

Solving Recurring relations:

Linear homogeneous recurrence relations with constant coefficients

The golden ratio:

The golden ratio, mean proportional, a geometric interpretation, ruler and compass construction, Euler construction, generation by Newton's method.

The golden ratio revisited:

The golden ratio revisited, the golden ratio and human body, golden ratio by origami, Differential equations, Gattei's discovery of goldenratio, centroids of circles,

Text 2 : Chapters 10, 20, 21

<u>Module V : Human rights (18 hours)</u>

Unit 1 - Human Rights

An Introduction to Human Rights, Meaning, concept and development –History of Human Rights-Different Generations of Human Rights- Universality of Human Rights- Basic International Human Rights Documents - UDHR ,ICCPR,ICESCR.-Value dimensions of Human Rights

Unit 2 - Human Rights and United Nations

Human Rights co-ordination within UN system- Role of UN secretariat- The Economic and Social Council- The Commission Human Rights-The Security Council and Human rights-The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.

Unit 3- Human Rights National Perspective

Human Rights in Indian Constitution – Fundamental Rights- The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights- Human Rights of Women-children –minorities- Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.

Text Books:

1. BharuchaErach – Text book of Environmental studies for UG Courses, University Press, II Edition
2. Thomas Koshy : Fibonacci and Lucas numbers with applications, John Wiley & Sons, Inc (2001).

References:

1. BharuchaErach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)

2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)
4. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)
5. Down to Earth, Centre for Science and Environment (Ref)
6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
7. Jadhav.H&Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
8. Mekinney, M.L &Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
11. Rao.M.N&Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
14. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)
16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
17. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p (Ref)

(M) Magazine (Ref) Reference (TB) Textbook

Human Rights

1. AmartyaSen, The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)

3. Law Relating to Human Rights, Asia Law House, 2001.
4. Shireesh Pal Singh, Human Rights Education in 21 st Century, Discovery Publishing House Pvt.Ltd, New Delhi,
5. S.K.Khanna, Children and the Human Rights, Common Wealth Publishers, 1998.2011.
6. Sudhir Kapoor, Human Rights in 21 st Century, Mangal Deep Publications, Jaipur,2001.
7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	0	**5**
II	3	2	1	**6**
III	2	2	1	**5**
IV	2	2	1	**5**
V	2	1	**1**	**4**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Work towards the social, economic and cultural upliftment	K3

	of human beings	
2	Promote and encourage the basic principles of liberty, equality, brotherhood and respect for fellow human beings	K3
3	Reframe their actions and decisions that affect the environment	K5
4	Develop knowledge and skills to confront severe environmental problems and take action to keep our environment healthy and sustainable for future generations	K6
5	Interpret the myriad properties of Fibonacci numbers and Golden ratio and fathom theorem applications to various disciplines	K2
6	Illustrate how mathematics manifests in nature through Fibonacci numbers and Golden ratio	K4
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating; K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

MATHEMATICS
(OPEN COURSE)

(DURING THE 5TH SEMESTER)

Semester **V**	Code: **UG21MT5OC01**	**APPLICABLE MATHEMATICS**	Total Hrs:**72** Hrs/Week:**4**	Credits: **4**

Course Objective

- Attain arithmetic, quantitative and problem solving skills
- Understand the basic ideas of differentiation and integration.

Syllabus

Module – I (18 hours)
Types of numbers, HCF & LCM of integers, Fractions, Simplifications (VBODMAS rule), squares and square roots, ratio and proportion, percentage, profit & loss.

Module – II (18 hours)
Quadratic equations (Solution of quadratic equations with real roots only), Permutations and combinations – simple applications, Trigonometry- introduction, values of trigonometric ratios of 0^0, 30^0, 45^0, 60^0& 90^0, Heights and distances.

Module – III (18 hours)
Simple interest, Compound interest, Time and work, Work and wages, Time and distance, exponential series and logarithmic series.

Module – IV (18 hours)

Elementary mensuration – Area and perimeter of polygons, Elementary Algebra, monomial , binomial, polynomial (linear, quadratic & cubic), simple factorization of quadratic and cubic polynomials.
Differential Calculus - Differentiation – Standard results (derivatives), Product rule, Quotient rule and function of function rule (without proof) and simple problems)

References:

1. M. Tyra, & K. Kundan- CONCEPTS OF ARITHMETIC, BSC PUBLISHING COMPANY PVT.LTD, C – 37, GANESH NAGAR, PANDAV NAGAR COMPLEX DELHI - 110092
2. GRE Math review (pdf)
3. Joseph Edward : Differential Calculus for beginners. Nabu Press (2011)
4. Calculus Volume I, S. Narayanan & T.K. Manikavachagam Pillai – S. Viswanathan (Printers & Publications) Pvt.Ltd
5. S Narayaynan, TK ManikavachagamPillai : Calculus Volume I, S Viswanathan Printers and publications Pvt. Ltd.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	2	1	**6**
II	3	2	1	**6**
III	3	2	1	**6**
IV	3	3	1	**7**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO	Upon completion of this course, the	Knowledge

No.	students will be able to:	Level
1	Understand basic mathematical concepts which helps in perform well in different competitive examinations	K2
2	Attain arithmetic and quantitative reasoning skills to understand and solve problems	K3, K4, K5
3	Able to solve a variety of problems using shortcut methods	K4, K5
4	Able to apply general mathematical models to solve different problems	K3, K4, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester V	Code: UG21MT5OC02	FINANCIAL MATHEMATICS	Total Hrs:**72**	Credits: 4
			Hrs/Week:**4**	

Course Objective

- Provide the knowledge of a range of mathematical and computational techniques that are required for a wide range of quantitative positions in the financial sector
- Understand in detail the theory of interest rates, use of cash flow models, simple and compound rates of interest and discount as well as compare and distinguish between nominal and effective rates of interest and discount

Syllabus

Module – 1 (18 Hrs)

Theory of interest rates : Rate of interest – Accumulation factors – Force of interest and Stoodley's formula for the force of interest. Basic Compound interest relations: Relationships between s, i, v, and d – The equation of value and yield on a transaction. Annuity certain: Present values and accumulations – Loan schedule for a level annuity – Continuously payable annuities and varying (increasing and decreasing) annuities. Nominal rates of interest: Annuities payable p –thly- present values and accumulations- Loan schedule for p-thly annuities.

Module – 2 (18Hrs)

Discounted cash flow: Net percent values and yields – The comparison two investment projects – The effects of inflation – The yield on a fund and measurement of investment performance. Capital Redemption Policies: Premium calculations- Policy values, Surrnder values, paid-up policy values and policy alterations, Stood ley's logistic model for the force of interest, reinvestment rates.

Module – 3 (18Hrs)

Valuation of securities: Fixed interest securities – Ordinary shares, prices and yields, perpetuities – Mak ham's formula, optional redemption dates – Effect of the term to redemption on the yield – Real returns and index linked stocks. Capital Gains Tax: Valuing a loan with allowance for capital gains tax - capital tax when the redemption price of the rate of tax is not constant - Finding the yield when there is capital gains tax - optional redemption dates – Offsetting capital losses against capital gains.

Module – 4 (18Hrs)

Cumulative Sinking Funds (Restricted coverage): The relationships between successive capital repayments – the term of the loan when the redemption price is constant.

Text Book:

1. McCutcheon and Scot Heinemann, An introduction to the Mathematics of Finance, Professional publishing

References:

1. Sheldon M.Ross -*An Introduction to Mathematical Finance*, Cambridge University Press.
2. John C. Hull - *Options, Futures, and other Derivatives*, Prentice Hall of India Pvt Ltd.
3. Salih N. Neftci - *An Introduction to the Mathematics of Financial Derivatives*, Academic press.
4. Robert J Elliot and P Ekkehard Kopp - *Mathematics of Financial Market*, Springer- Verlag, New York Inc.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	1	**7**
II	3	2	1	**6**
III	3	2	1	**6**
IV	3	2	1	**6**

Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Define and describe in detail the use of cash flow models, simple and compound rates of interest and discount as well as compare and distinguish between nominal and effective rates of interest and discount.	K3, K4, K5
2	Describe in detail the various types of annuities and perpetuities and use them to solve financial transaction problems.	K3, K4, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester V	Code: UG21MT5OC03	MATHEMATICAL ECONOMICS	Total Hrs:**72**	Credits: **4**
			Hrs/Week:**4**	

Course Objective

- Improve the mathematical skills necessary to study economics
- Explore techniques to solve complex problems
- Understand the several economic theories that explain different aspects of buying behavior.

Syllabus

Module I : Demand and Supply Analysis (18 hrs)

Utility and demand – the meaning of demand and quantity demanded – the law of demand – demand curve – market demand curve – reasons for the law of demand – slope of a demand curve – shifts in demand – demand function and demand curve – the meaning of supply – supply function – law of supply – slope of a supply curve – shifts in supply – market equilibrium – price elasticity of demand – measurement of price elasticity – arc elasticity of demand – cross elasticity of demand.

(Relevant sections chapters 5 and 7 of Text -1)

Module II: Cost and Revenue Functions (15 hrs)

Cost function: Average and marginal costs, Short run and long run costs, Shapes of average cost curves in the short run and long run and its explanation, Revenue function, Marginal revenue (MR) and Average Revenue (AR) functions, Relation between MR, AR and Elasticity of demand.
(Relevant sections of chapter 19 & 21 of Text - 1)

Module III: Theory of Consumer Behaviour (15 hrs)
Cardinal utility analysis – the Law of diminishing marginal utility – the Law of equi-marginal utility – Indifference curves – Ordinal utility – Indifference map – Marginal rate of substitution – Properties of indifference curves.
(Relevant sections of chapters 9 and 11 of Text -1)

Module IV: Economic Applications of Derivatives (24 hrs)
Economic Applications of Derivatives. Marginal, average and total concepts optimizing economic functions - Functions of several variables and partial derivatives, Rules of partial differentiation, Second order partial derivatives, Optimization of multivariable functions, Constrained optimization with Lagrange multipliers, Significance of the Lagrange multiplier, Total and partial derivatives – total derivatives.
Marginal productivity, Income determination, multipliers and comparative statics, Income and cross elasticity of demand, Optimization of multivariable function in Economics constrained optimization of multivariable functions in Economics.
(Chapter 4– Sections 4.7 and 4.8; chapter 5 and chapter 6 sections 6. 1 to 6.5 – of text 2).

Text books:

1. H.L. Ahuja : Principles of Micro Economics, 15th Revised Edition, S. Chand
2. Edward T. Dowling: Introduction to Mathematical Economics, Schaum's Outline Series, Third edition, TMH.

References:

1. Singh, Parashar, Singh --*Econometrics & Mathematical Economics*, S. Chand & Co. 1997.
2. R.G.D. Allen - Mathematical Analysis for Economists, Macmillan, ELBS.
3. Edward T. Dowling - Introduction to Mathematical Economics, Third edition, Schaum's Outline Series, TMH.
4. Henderson &Quandt - Microeconomic Theory: A Mathematical Approach, 3rd Edition, TMH.
5. Taro Yamane - Mathematics for Economists: An elementary survey. Second Edition, PHI.
6. SrinathBaruah - Basic Mathematics and its Application in Economics, Macmillan.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total

I	3	2	1	**6**
II	3	2	1	**6**
III	3	2	1	**6**
IV	3	3	1	**7**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand the meaning of demand and quantity and relativity between Demand and Supply	K2
2	Draw Demand-Supply curve	K2, K3
3	To deal with problems of Cost and Revenue Functions	K3
4	Understand the Theory of Consumer Behaviour and concepts of optimization	K2
5	To evaluate Marginal productivity and Income determination	K5
6	Model economic questions as mathematical problems	K5, K6

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Learning Pedagogy

Semester **V**	Code: **UG21MT5OC04**	**MATHEMATICAL MODELLING**	Total Hrs:**72**	Credits: **4**
			Hrs/Week:**4**	

Course Objective

- This course is an **introduction to mathematical modeling** using graphical, numerical, symbolic, and verbal techniques to describe and explore real-world data and phenomena.-
- demonstrate connections among different mathematical topics.
- Understand the different types of linear and non linear models
- Apply numerical methods in simulation models
- Use the programming language C to execute the mathematical models.

Syllabus

MODULE-1:INTRODUCTION (18 Hrs)

Mathematical modelling-what and why? Classification of mathematical models, Characteristics of mathematical models, Mathematical modelling through geometry, algebra, trigonometry and calculus, Limitations of mathematical modelling.

Text Book 1 (Chapter-1: Sections 1.1 to 1.9 ; Page Nos. 1-29)

MODULE-2 : MODELLING THROUGH FIRST ORDER (18 Hrs)

Linear growth and decay models, Non-linear growth and decay models, Compartment models, Modelling in dynamics and Modelling of geometrical problems.

Text Book 1 (Chapter-2: Sections 2.1 to 2.6; Page Nos.30 -52.)

MODULE-3 : SYSTEM SIMULATION(18 Hrs)

Introduction, Examples, Nature of simulation, Simulation of a chemical reactor, Euler and Runge-Kutta integration formulae, Simulation of a water reservoir system, Simulation of a servo system. (Write and execute all the computer programs throughout this course using C)

Text Book 2 (Chapter-1: Sections 1.1 to 1.7 & Chapter-2: Sections 2.1 to 2.6 and 2.9; Page Nos. 1-39)

MODULE-4: DISCRETE SYSTEM SIMULATION (18Hrs)

Fixed time-step vs. event-to-event model, On simulating randomness, Monte-Carlo computation vs. stochastic simulation, Rudiments of queuing theory, Simulation of a single-server queue.

Text Book 2 (Chapter-3: Sections 3.1 to 3.7 and Chapter-4: Sections 4.1 & 4.2; Page Nos. 40-76)

Text books:

1. Mathematical modelling- J.N.Kapoor, New Age International, 2001 Reprint.
2. System simulation with digital computer- NarsingDeo, Prentice Hall of India, Sixth printing, 1996.

References:

1. System simulation – Geoffrey Gordon, Prentice Hall of India, Second edition.
2. Mathematical modeling for industry and engineering- Thomas Svobodny, Prentice Hall.
3. Mathematical modeling- F.R.Giordano, M.D.Weir&WilliamP.Fox, Third edition.
4. A practical course in differential and mathematical modeling- Ibragimov N.H, Alga Publications.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	1	**7**
II	3	2	1	**6**
III	3	2	1	**6**

IV	3	2	1	**6**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

No.	**students will be able to:**	**Level**
1	Understand various mathematical models its classification and characteristics	K2, K3
2	Understand modelling dynamics and modelling of geometric problems	K2, K3
3	Understand basics of simulation modelling	K2, K3
4	Apply analytical techniques to solve a mathematical model	K4, K5

Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

SEMESTER SIX

MATHEMATICS (CORE COURSE)

Semester **VI**	Code: **UG21MT6CR01**	**REAL ANALYSIS**	Total Hrs: **90** Hrs/Week: **5**	Credits: **4**

Course Objective

- Develop an understanding of the theory of sequences and series, continuity, differentiability and integration of functions defined on subsets of real line.
- Introduce the difference between point wise and uniform convergence of a sequence of functions.
- Equip the students to determine the Riemann integrability of a bounded function and prove a selection of theorems concerning integration.
- Learn to prove results and develop solutions to problems that arise in the context of real analysis

Syllabus

Module I : Infinite Series (20 hrs)

A necessary condition for convergence. Cauchy`s general principle of convergence for a series. Positive term series. A necessary condition for convergence of positive term series. Geometric series. The comparison series $\sum\frac{1}{hP}$ comparison test for positive term series without proof. Cauchy`s root test DALEMBERTÈS RATIO test. Raabe's test. Gauss`s test. Series with arbitrary terms. Alternating series. Absolute convergence

(Section 1.1 to 1.4, 2 , 2.1 to 2.3, 3 ,4, 5, 6, 9, 10, 10.1, 10.2 of chapter 4 of Text 1)

Module II :Continuous functions (25 hrs)

Continuous function (a quick review). Continuity at a point, continuity in an interval. Discontinuous functions. Theorems on continuity. Functions continuous on closed intervals. Uniform continuity.

(Section 2.1 to 2.4 , 3, 4 of chapter 5 of Text 1)

Module III :Riemann Integration (30 hrs)

Definitions and existence of the integral. Inequalities of integrals. Refinement of partitions of integrability. Integrability of the sum of integrable functions. The integrals as the limit of a sum. Some applications. Some integrable functions. Integration and differentiation. The fundamental theorem of calculus.

(Section 1 to 9 of chapter 9 of Text 1)

Module IV :Uniform Convergence (15hrs)

Point wise convergence. Uniform convergence on an interval. Cauchy`s criterion for uniform convergence. A test for uniform convergence of sequences. Test for uniform convergence of series. Weierstrass`s M-test, Abel`s test. Statement of Dirichelet`s test without proof.

(Section 1 to 3.2 of Text 1)

Text Books:

1. S.C.Malik and SavithaArora - Mathematical analysis. Fourth edition.

References:

1. Robert G Bartle and Donald R Sherbert–Introduction to real analysis 3rd edition.
2. Shanti Narayan and P.K Mital – A Course of Mathematical Analysis , S. Chand and Co Ltd(2004)
3. J. V Deshpande – Mathematical analysis and Applications
4. R. A. Gordon - Real Analysis 2nd Edn. (Pearson)

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	4	2	1	**7**
II	3	3	1	**7**
III	3	2	2	**7**
IV	2	2	0	**4**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Determine the continuity and differentiability of functions defined on subsets of real line	K4
2	Recognize the difference between point wise and uniform convergence of a sequence of functions	K2, K4
3	Determine the Riemann integrability of a bounded function and prove a selection of theorems concerning integration	K4
4	Produce rigorous proofs of results and develop solutions to problems that arise in the context of real analysis	K3, K6
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester **VI**	Code: **UG21MT6CR02**	**COMPLEX ANALYSIS**	Total Hrs:**90**	Credits: **4**
			Hrs/Week:**5**	

Course Objective

- Introduce the notion of functions on complex variables, analyticity, harmonic functions and contour integration.
- Develop the geometric understanding of functions on one complex variable.
- Series representation of complex functions and the evaluation of singular points and residues.

Syllabus

Module I : Analytic functions (30 hours)

Functions of a complex variable-limits-theorems on limits-continuity-derivatives-differentiation formulas-Cauchy-Riemann equations-sufficient condition for differentiability-analytic functions examples-harmonic functions.Elementary functions, Exponential function –logarithmic function –complex exponents –trigonometric functions- hyperbolic functions- inverse trigonometric and

hyperbolic functions.
Chapter 2 (Sections 12, 15, 16, 18 to 22, 24, 25, 26) Chapter 3 (Sections 29, 30, 33 to 36)

Module II : Integrals (25 hours)
Derivatives of functions –definite integrals of functions –contours –contour integrals –some examples –upper bounds for moduli of contour integrals –ant derivates –Cauchy-Goursat theorem (without proof)- simply and multiply connected domains- Cauchy's integral formula- an extension of Cauchy's integral formula- Liouville's theorem and fundamental theorem of algebra- maximum modulus principle.
Chapter 4 (Sections 37 to 41, 43, 44, 46, 48 to 54) Chapter 5 (Sections 55 to 60 and 62)

Module III : Series (15 hours)
Convergence of sequences and series -Taylor's series -proof of Taylor's theorem-examples- Laurent's series(without proof)-examples.
Chapter 6 (Sections 68 to 70 and 72 to 74)

Module IV: Residues and poles (20 hours)
Isolated singular points –residues –Cauchy's residue theorem –three types of isolated singular points-residues at poles-examples –evaluation of improper integrals-example –improper integrals from Fourier analysis –Jordan's lemma (statement only) –definite integrals involving sines and cosines.
Chapter 7 (Sections 78 to 81 and 85)

Text Books:
1. James Ward Brown &Ruel. V. Churchill- Complex variables and applications (8^{th} edition)

References:
1. Shanti Narayan - Theory of functions of a complex variable
2. B. Choudhary- The Elements of Complex Variables.
3. A. David Wunsch – Complex Analysis with Applications (Pearson)
4. Murray R. Spiegel – Theory and Problems of Complex Variables, Schaum's Outline Series

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	5	3	1	**9**
II	3	3	1	**7**

III	2	1	1	**4**
IV	2	2	1	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand complex numbers algebraically and geometrically	K2
2	Conceive the concept of analytic functions and will be familiar with the elementary complex functions and their properties	K2, K3
3	Familiar with the theory and techniques of complex integration	K3, K5
4	Familiar with the theory and application of the power series expansion of analytic functions and evaluation of residues.	K3, K5
5	Use the residue theorem to compute complex line integrals and real integrals	K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester **VI**	Code: **UG21MT6CR03**	**DISCRETE MATHEMATICS**	Total Hrs:**108**	Credits: **4**
			Hrs/Week:**6**	

Course Objective

- To familiarize how graphs serve as models for many standard problems.
- To discuss the concepts of graphs, trees, Eulerian graphs, Hamiltonian graphs
- Introduction to number theory with applications
- Introduction to Lattices theory

Syllabus

Module I : Graph Theory (30 Hrs)

An introduction to graph. Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, The matrix representation of graphs

Text 1 (Sections 1.1, 1.3 to 1.7, 2.1, 2.2 &2.3)

Module II : Graph Theory (35 Hrs)

Trees. Definitions and Simple properties, Bridges, Spanning trees. Cut vertices and Connectivity. Euler's Tours, The Chinese postman problem. Hamiltonian graphs and the travelling salesman problem.

Text 1 (Sections 2.1, 2.2, 2.3, 2.6, 3.1 (algorithm deleted), 3.2(algorithm deleted) 3.3, and 3.4 (algorithm deleted))

Module III : Number Theory (25 Hrs)

The Division Algorithm, The Greatest Common Divisor,The Euclidean Algorithm,
The Fundamental Theorem of Arithmetic and Basic Properties of Congruence, Fermat's Theorem, Wilson's Theorem, The sum and number of divisors, Euler's Phi-Function, Euler's Theorem.

Text 2 (Sections 2.2, 2.3, 2.4, 3.1 and 4.2) (Sections 5.2 (pseudoprimes is excluded), 5.3 (up to theorem 5.5), 6.1(definitions and statements only, proofs of the theorems excluded), 7.2(definitions and statements only, proofs of the theorems excluded), 7.3(definitions and statements only, proofs of the theorems excluded)

Module IV :Poset and Lattices (18 Hrs)

Definition of Poset, Diagramatical Representation of a Poset, Isomorphisms, Duality, Lattices, Complete Lattices, Sublattices.

(Relevant topics in Chapter 2 of text 3)

Text Books:

1. John Clark, Derek Allen Holton - A first look at graph theory, Allied Publishers
2. David M Burton - Elementary Number Theory, 7th Edition ,McGraw Hill Education(India) Private Ltd.
3. Vijay K. Khanna -Lattices and Boolean Algebras- First Concepts, Vikas Publishing House Private Ltd.

References:

1. Douglas B West, Peter Grossman - Introduction to Graph Theory
2. R. Balakrishnan, K. Ranganathan - A textbook of Graph Theory, Springer International Edition
3. S.Arumugham, S. Ramachandran - Invitation to Graph Theory, Sci. tech. Peter Grossman.
4. S. Bernard and J.M Child: Higher Algebra, AITBS Publishers, India,2009

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Total

	2 Mark	5 Marks	15 Marks	
I	4	2	1	**7**
II	4	3	2	**9**
III	3	2	1	**6**
IV	2	2	0	**4**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand graphical terms and get the ability to model real world problems through graphs.	K2
2	Distinguish between Hamiltonian and Eulerian graphs.	K4
3	Attain the ideas of Posets and Tosets	K2
4	Gets concrete knowledge about Lattice Structure.	K2, K4
5	Understand basis of modular arithmetic and use it to solve linear congruence's	K2, K5
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester **VI**	Code: **UG21MT6CR04**	**LINEAR ALGEBRA AND METRIC SPACES**	Total Hrs:**90** Hrs/Week:**5**	Credits: **4**

Course Objective

- To develop a geometric understanding of finite dimensional vector spaces, relation between matrix algebra and linear transformations.
- Introduce to the concept of matric spaces and its properties
- Develop an understanding of distance as a mathematical function in various spaces.

Syllabus

Module I (25 hours)
Vector spaces: Vectors, Subspace, Linear Independence, Basis and Dimension, Row Space of a Matrix.
Text 1 Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4 and 2.5)

Module II (30 hours)

Linear Transformations: Functions, Linear Transformations, Matrix Representations, Change of Basis, Properties of Linear Transformations.

Text 1 Chapter 3 (Sections 3.1, 3.2, 3.3, 3.4 and 3.5)

Module III (15 hours)

Metric Spaces – Definition and Examples, Open sets, Closed Sets. , Cantor set

Text 2 Chapters 2 (Sections 9, 10 and 11)

Module IV (20 hours)

Convergence, Completeness, Continuous Mapping

Text 2 Chapter 2 (Sections 12 and 13)

Text Books:

1. Richard Bronson, Gabriel B.Costa - Linear Algebra An Introduction (Second Edition), Academic Press 2009, an imprint of Elsevier.
2. George F Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.

References:

1. I. N. Herstein – Topics in Algebra , Wiley India
2. Harvey E. Rose - Linear Algebra, A Pure Mathematical Approach, Springer
3. Devi Prasad, - Elementary Linear Algebra, Narosa Publishing House
4. K. P. Gupta – Linear Algebra, PragathiPrakashan
5. Derek J. S. Robinson – A Course in Linear Algebra with Applications, Allied.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	1	**7**
II	4	3	1	**8**
III	3	2	1	**6**
IV	2	1	1	**4**
Total No. of	**12**	**9**	**4**	**25**

Questions				
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Develop a geometric understanding of finite dimensional vector spaces and linear transformations	K2
2	Relate matrix algebra to linear transformations	K4
3	Identify the relation between linear dependence, linear independence with the rank of a matrix	K2, K4
4	Identify the relationship between dimension of a vector space and the rank of a matrix	K4
5	Visualize the concept of distance as a mathematical function in various spaces	K3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

MATHEMATICS
(CHOICE BASED COURSE)
(DURING THE 6TH SEMESTER)

Semester VI	Code: UG21MT6CB01	OPERATIONS RESEARCH	Total Hrs: **72**	Credits: **3**
			Hrs/Week: **4**	

Course Objective

- Learn to formulate the mathematical model and solve linear programming problems in different methods.
- Understand the concept of duality and solve linear programming problem using duality.
- Learn to solve transportation problem and assignment problem.
- Introduce the concepts of queueing theory

Syllabus

Module I :Linear Programming:- Model formulation and solution by the Graphical Method and the Simplex method (20Hrs.)

General Mathematical Model of LPP, Guidelines on linear Programming model formulation and examples of LP Model formulation. Introduction to graphical method, definitions, Graphical solution methods of LP Problems, Special cases in linear Programming, Introduction to simplex method, Standard form of an LPP, Simplex algorithm(Maximization case),Simplex algorithm (Minimization case),The Big M Method, Some complications and their resolution, Types of linear Programming solutions.

Chapter 2: Sections 2.6 to 2.8
Chapter 3: Sections 3.1 to 3.4
Chapter 4: Sections 4.1 to 4.6

Module II: Duality in Linear Programming (12 Hrs.)

Introduction, Formulation of Dual LPP, standard results on duality, Advantages of Duality, Theorems of duality with proof.
Chapter 5: Sections: 5.1 to 5.3, 5.5 with appendix.

Module III: Transportation and Assignment Problems (22 Hrs.)

Introduction, Mathematical model of Transportation Problem, The Transportation Algorithm, Methods for finding Initial solution, Test for optimality, Variations in Transportation Problem, Maximization Transportation problem,Introduction and mathematical models of Assignment problem, Solution methods of Assignment problem, variations of the assignment problem.

Chapter 9: Sections 9.1 to 9.7
Chapter 10 : sections 10.1 to 10.4

Module IV: Queuing Theory(15 hrs)

Introduction, Essential features of queuing system, Calling population, Characteristic Queuing Process, Queue discipline, Service Process (or Mechanisms) , Performance measure of Queuing system. Transient- state and Steady – state, Relationship among Performance measure. Probability distribution in Queuing system, Distribution of arrival (Pure Birth Process), Distribution of interarrival times (Exponential process) Distribution of departure (Pure Death Process) Distribution of Service Times.
Chapter 16 (Section 16.1 to 16.4)

Text books:

1. J. K. Sharma : Operation Research Theory and Application (4rd edition) Macmillan Publishers, India Ltd.

References:

1. Operation Research by KantiSwarup, P. K. Gupta and Man Mohan - (Sultan Chand and Sons)
2. Ravindran A, Philip D.T. and Solberg J.J. , Operation Research; John Wiley and Sons
3. Hamdy A Taha-Operations Research-An introduction (seventh edition), Prentice Hall of India Pvt.Ltd.).
4. K. V Mital and C. Mohan - Optimization Methods in Operations Research and System Analysis (3rd edition) (New Age International)

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	4	2	2	**8**
II	1	3	0	**4**
III	4	2	2	**8**
IV	3	2	0	**5**
Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand Linear programming modal formulation and able to solve LP problems in two dimension graphically.	K2, K5
2	Write a given LPP in standard form and in a canonical form	K2, K3
3	Identify a feasible solution, a basic feasible solution, and an optimal solution using simplex method	K4, K5
4	Understands duality theorems and method to find optimal solutions using dual simplex method	K2

5	Identify the Transportation Problem and formulate it as an LPP and hence solve the problem	K2, K5
6	Determine that an Assignment problem is a special case of LPP and hence solve by Hungarian method	K3, K4, K5
7	Identify the queuing models	K2
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester VI	Code: UG21MT6CB02	TOPOLOGY	Total Hrs:**72**	Credits: 3
			Hrs/Week:**4**	

Course Objective

Learning Pedagogy

- Familiarize with the fundamental concepts of topological spaces.
- Learn properties of topological spaces

Syllabus

Module – 1 (17 Hrs)

Topological Spaces, Basis for a Topology, The product Topology on X x Y, The Subspace Topology.

Module – 2 (33 Hrs)
Closed sets and Limit Points, Continuous functions, The Metric Topology

Module – 3 (12 Hrs)
Connected Spaces, Connected subspaces in the Real Line

Module – 4 (10 Hrs)
Compact Spaces

Chapter – 2 (Sections 12, 13, 15, 16, 17, 18, 20)
Chapter – 3 (Sections 23,24, 26)

Text books:

1. James R Munkres -Topology - Second Edition, PEARSON PRENTICE HALL, First Impression, 2006.

References:

1. Introduction to Topology and Modern Analysis – G. F. Simmons

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	3	3	1	**7**
II	3	3	2	**8**
III	3	2	1	**6**
IV	3	1	0	**4**
Total No. of Questions	**12**	**9**	**4**	**25**

No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand basic terms and definitions of General topology	K2
2	Understand concepts such as closed set, limit point and continuity in Topological space.	K2, K3
3	Understand few fundamental properties of Topological Spaces	K2
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester **VI**	Code: **UG21MT6CB03**	**FUZZY MATHEMATICS**	Total Hrs:**72** Hrs/Week:**4**	Credits: **3**

Course Objective

- Learn to handle real world problems having uncertain and imprecise data.
- Develop an understanding of the fuzzy sets
- Study the operations on fuzzy sets.

Syllabus

Module - I(10 Hrs)
Introduction, Crisp Sets: An Overview,Fuzzy Sets: Basic Types ,Fuzzy Sets: Basic concepts.
Chapter 1 (Sections 1.1, 1.2, 1.3 and 1.4)

Module - II (10 Hrs)
Additional properties of α cuts, Representation of fuzzy sets, Extension principle of fuzzy sets.
Chapter 2 (Sections 2.1, 2.2 , 2.3)

Module - III : Operations on Fuzzy Sets (30 Hrs)
Types of Operations , Fuzzy complements , Fuzzy intersections: t – norms, Fuzzy Unions: t–conorms, Combinations of operations. (Theorems 3.7, 3.8, 3.11,3.13, 3.16 and 3.18 statement only)
Chapter 3 (Sections 3.1, 3.2, 3.3, 3.4, 3.5)

Module – IV : Fuzzy Arithmetic (22 Hrs)
Fuzzy numbers , Arithmetic operations on Intervals , Arithmetic operations on Fuzzy numbers. (Exclude the proof of Theorem 4.2) Lattice of fuzzy numbers, Fuzzy equations
Chapter 4 (Sections 4.1, 4.3, 4.4, 4.5, 4.6)

Text books:

1. George J. Klir / BoYuan, *Fuzzy Sets and Fuzzy Logic, Theory and Applications'*, Prentice Hall of India Private Limited, New Delhi, 2009.

References:

1. H.J Zimmermann, *Fuzzy Set Theory- and its Applications,* Allied Publishers, 1996.
2. Dubois. D and H. Prade, *Fuzzy Sets and System: Theory and Applications*, Academic Press, New York, 1988

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	2	1	0	**3**
II	2	2	1	**5**
III	4	3	2	**9**
IV	4	3	1	**9**

Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	To handle the real world problem having uncertain and imprecise data	K3
2	Understand representation of fuzzy sets	K2, K3
3	Understand operations on fuzzy sets	K2, K3
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

Semester **VI**	Code: **UG21MT6CB04**	**HISTORY OF INDIAN MATHEMATICS**	Total Hrs:**72** / Hrs/Week:**4**	Credits: **3**

Course Objective

- Learn the history of ancient Indian Mathematics and transmission of Kerala Mathematics.
- Help the students to understand the origin and development of Mathematical concepts.
- To build a passion towards mathematics.

Syllabus

Module I: Introduction (12 hrs.)

Chapter 1: The History of Mathematics, Alternative perspectives, justification, development of Mathematical knowledge, mathematical signposts and transmissions across the ages.

Module II: Ancient Indian Mathematics (24 hrs.)

Chapter 8 Sections: A restatement of intent and a brief historical sketch, Maths from bricks: Evidence from the Harappan culture, Mathematics from the Vedas Early Indian Numerals and their development, Jaina Mathematics, Mathematics on the eve of the classical period.

Module III: Indian Mathematics: The Classical Period and After (20 hrs.)

Chapter 9 Sections: Major Indian mathematician-astronomers, Indian algebra, Indian trigonometry, Other notable contributions.

Module IV: A Passage to Infinity: The Kerala Episode (16 hrs.)

Chapter 10 Sections: The actors, Transmission of Kerala Mathematics

Text books:

1. The Crest of the Peacock - 3rd Edition, George Geeverghese Joseph. Princeton University Press, Princeton & Oxford.

References:

1. Kim Plofker ; Mathematics In India ; Hndustan Book Agency
2. History of Science and Technology in ancient India: the beginnings, D. Chattopadhyaya. Firma KLM Pvt Calcutta 1986.
3. History of Hindu Mathematics, B. Datta and A.N. Singh, BharatiyaKalaPrakashanN.Delhi 2001 (reprint)
4. Studies in the History of Indian Mathematics (Culture and History of Indian Mathematics) C. S. Seshadri (Editor), Hindustan Book Agency (15 August 2010)
5. An introduction to the history of Mathematics 5th Edn, H. Eves. Saunders
6. Philadelphia 1983.
7. A history of Mathematics, C.B. Boyer. Princeton University Press, NJ, 1985.

QUESTON PAPER PATTERN

Module	Part A 2 Mark	Part B 5 Marks	Part C 15 Marks	Total
I	2	1	1	**4**
II	3	3	1	**7**
III	4	3	1	**8**
IV	3	2	1	**6**

Total No. of Questions	**12**	**9**	**4**	**25**
No. Questions to be answered	**10**	**6**	**2**	**18**
Total Marks	**20**	**30**	**30**	**80**

Course Outcomes

CO No.	Upon completion of this course, the students will be able to:	Knowledge Level
1	Understand the history of ancient Indian Mathematics and transmission of Kerala Mathematics	K2
2	Get familiarized with the origin and development of various mathematical concepts	K2
3	Develop knowledge and passion towards Mathematics	K2, K3
4	Understand the history of ancient Indian Mathematics and transmission of Kerala Mathematics	K2
Knowledge Levels: K1-Remembering; K2-Understanding; K3-Applying; K4-Analyzing; K5-Evaluating;K6-Creating.		

Learning Pedagogy

Chalk and talk, Multimedia projection, e-content, Group discussion, Seminar, Interactive sessions, Tutorials, Assignment, Quiz, LMS

Assessment Tools

Assignments, Seminar, Test papers, End semester examination, online test and assignments

PROJECT REPORT GUIDELINES

PROJECT EVALUATION: (Maximum Marks 100)

All students are to do a project in the area of core course. This project can be done individually or in groups(not more than five students) which may be carried out in or outside the campus. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners (Internal and External) appointed by the Controller of Examinations. External Project evaluation and Viva /

Presentation is compulsory for all subjects and will be conducted at the end of the programme.

For Projects

a) Marks of External Evaluation :80

b) Marks of Internal Evaluation : 20

Components of External Evaluation of Project	**Marks**
Dissertation (**External)**	50
Viva – Voce **(External)**	30
Total	**80**

*Marks for Dissertation may include study tour report if proposed in thesyllabus

***Components of Internal Evaluation of Project**	**Marks**
Punctuality	5
Experimentation/Data collection	5
Knowledge	5
Report	5
Total	**20**

MODEL QUESTION PAPERS

B.Sc. DEGREE (CBCS) EXAMINATION

First Semester
Programme: Mathematics

Core Course – UG21MT1CR01 – FOUNDATIONS OF MATHEMATICS

Time: 3 hrs. Max. Marks: 80

PART A (Short Answer)
(Answer any ten questions. Each question carries 2 marks)

1. What is the value of the variable x after the statement if:$2 + 2 = 4$ then $x := x + 1$ if $x = 0$ before this statement is encountered?
2. Write the dual of the compound proposition $p \wedge (q \vee (r \wedge t))$.
3. Express the statements using predicates and quantifiers: $There\ is\ a\ horse\ that\ can\ climb$.
4. If A and B are sets then prove that $A \cap B = B \cap A$.
5. If $f: R \to R$ is defined as $f(x) = x^2$. Find $f^{-1}(\{1\})$.
6. What is the cardinality of the set $\{\{a\}\}$?
7. How many relations are there on a set with n elements?
8. Find the matrix representing the relation SoR where R and S are represented by the matrix $M_R = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ and $M_S = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 1 \end{pmatrix}$ respectively.
9. Show that 'greater than or equal to' is a partial ordering on the set of integers.
10. Prove that if A is a n-square matrix then $\mathrm{A} + \mathrm{A}'$ is symmetric.
11. Find the rank of $\begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 5 \\ 2 & 4 & 8 \end{pmatrix}$.
12. Find the eigen values of $\begin{pmatrix} 0 & 2 \\ -2 & 0 \end{pmatrix}$. (10×2=20)

PART B (Short Essay)
(Answer any six questions. Each question carries 5 marks)

13. Using truth table verify $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$.
14. Show that if n is an integer and $n^2 + 5$ is odd then n is even by the method of contraposition.
15. Let $f : R \to R$ be defined by $f(x) = x^2$. Find
    a) $f^{-1}\{4\}$ b) $f^{-1}\{x/0 < x < 1\}$ c) $f^{-1}\{x \,/\, x > 4\}$.
16. If a and r are real numbers and $r \neq 0$ then
    $$\sum_{j=0}^{n} ar^j = \frac{ar^{n+1} - a}{r - 1}\ if\ r \neq 1$$
    $$(n+1)a \text{ if } r = 1$$
17. Suppose that A is a non empty set and f is a function that has A as its domain. Let R be the relation on A consisting of all ordered pairs (x,y) such that $f(x) = f(y)$. Show that R is an equivalence relation.
18. Find a compatible total ordering for the poset $(\{1, 2, 4, 5, 12, 20\}, /)$ where $/$ is the divides relation.

19. Reduce the matrix $A = \begin{pmatrix} 1 & 3 & 6 & -1 \\ 1 & 4 & 5 & 1 \\ 1 & 5 & 4 & 3 \end{pmatrix}$ to normal form N and compute the matrices P and Q such that PAQ=N.

20. Find all non trivial solutions of $\begin{array}{l} 2x_1 - x_2 + 3x_3 = 0 \\ 3x_1 + 2x_2 + x_3 = 0 \\ x_1 - 4x_2 + 5x_3 = 0 \end{array}$

21. Find the characteristic equation and roots for the matrix $\begin{pmatrix} -2 & -8 & -12 \\ 1 & 4 & 4 \\ 0 & 0 & 1 \end{pmatrix}$ (6×5=30)

PART C (Long Essay)
(Answer any two questions. Each question carries 15 marks)

22. i) Prove by direct method that 'the sum of two odd integers is even'.
    ii) Prove by method of contradiction that 'the sum of an irrational number and a rational number is irrational'.
    iii) Prove or disprove that 'product of two rational numbers is rational'.

23. a) Prove that if R is an equivalence relation on a set S, then the equivalence classes of R form a partition of S. Also prove that given a partition $\{A_i / i \in I\}$ of the set S, then there is an equivalence relation R that has the sets $A_i, i \in I$ as its equivalence classes.
    b) List the ordered pairs in the equivalence relation R produced by the partition $A_1 = \{1,2,3\}, A_2 = \{4,5\}$ and $A_3 = \{6\}$ of $S = \{1,2,3,4,5,6\}$.

24. Determine the characteristic roots and a basis of each of the associated invariant vector spaces of the matrix $\begin{pmatrix} 2 & 2 & 0 \\ 2 & 2 & 0 \\ 0 & 0 & 1 \end{pmatrix}$.

25. Verify Cayley Hamilton theorem for the matrix $A = \begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 2 \end{pmatrix}$. Hence find A^{-1} and A^3.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

First Semester

Complementary Course – UG21MT1CM01 – PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND NUMERICAL METHODS

(Complementary Mathematics for B.Sc. Physics/Chemistry)

Time: 3 hrs. Max. Mark: 80

PART A (Short Answer)

(Answer any ten questions. Each question carries 2 marks)

1. Find the domain and range of the function $f(x,y) = \frac{1}{xy}$.
2. Find all the first and second order partial derivatives of $f(x,y) = xcosy + ye^x$.
3. Find $\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}, \frac{\partial f}{\partial z}$ if $\mathrm{f(x, y, z) = ln\ (x + 2y + 3z)}$.
4. Show that $A + (\bar{A}')$ is hermitian.
5. Define an invariant vector.
6. State Cayley Hamilton theorem.
7. Find the expansion of cos6θ using DeMoviers theorem.
8. Express tan9θ in terms of powers of tanθ.
9. Separate in to real and imaginary parts cos $(\alpha + i\beta)$.
10. Explain method of chords.
11. Find the real and imaginary parts of sinh $(\alpha + i\beta)$.
12. Explain the method of iteration. (10×2=20)

PART B (Short Essay)
(Answer any six questions. Each question carries 5 marks)

13. Find $\frac{\partial z}{\partial x}$ if the equation $\mathrm{yz - lnz = x + y}$, defines z as a function of the two independent variables x and y.
14. Use the chain rule to find the derivative of $w = xy$ with respect to θ along the path $x = cos\theta, y = sin\theta$. What is the derivative value at $= \frac{\pi}{2}$?
15. Using implicit differentiation find $\frac{dy}{dx}$ if $xy + y^2 - 3x - 3 = 0$ at the point (-1,1).
16. Solve the following system using Cramer's rule $5x - 3y = 37$
$$-2x + 7y = -38$$
17. Find the characteristic equation and roots for the matrix $\begin{pmatrix} 1 & 2 & 2 \\ 0 & 2 & 1 \\ -1 & 2 & 2 \end{pmatrix}$.
18. If $\sin(\theta + i\phi) = cos\alpha + i \sin\alpha$, then prove that $cos^2\theta = \pm \sin\alpha$.
19. Separate into real and imaginary parts $tan^{-1}(\cos\theta + i\sin\theta)$.
20. Find a real root of the equation $e^{-x} = 10x$ by method of iteration.
21. Using Newton Raphson Method solve the equation $x - cosx = 0$. (6×5=30)

PART C (Long Essay)
(Answer any two questions. Each question carries 15 marks)

22. Determine the characteristic roots and a basis of each of the associated invariant vector spaces of the matrix $\begin{pmatrix} 5 & 6 & -10 & 7 \\ -5 & -4 & 9 & -6 \\ -3 & -2 & 6 & -4 \\ -3 & -3 & 7 & -5 \end{pmatrix}$

23. Verify Cayley Hamilton theorem and find A^3 and A^{-1}, if $A = \begin{pmatrix} 2 & 2 & 0 \\ 0 & 2 & 2 \\ 0 & 0 & 1 \end{pmatrix}$

24. a) Find the sum of the series $1 - \cos\alpha\cos\beta + \frac{cos^2\alpha \cos 2\beta}{2!} - \frac{cos^3\alpha\cos 3\beta}{3!} + \cdots$
    b) Show that $tanh^{-1}x = sinh^{-1}\frac{x}{\sqrt{1-x^2}}$

25. a) What is the geometrical interpretation of bisection method?
    b) Find the real root of the equation $x^3 - 3x - 5 = 0$ by bisection method.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

First Semester

Complementary Course – UG21MT1CM02 – DIFFERENTIAL CALCULUS, LOGIC AND BOOLEAN ALGEBRA

(Complementary Mathematics for B.Sc. Statistics)

Time: 3 hrs. Max. Marks: 80

PART A (Short Answer)
(Answer any ten questions. Each question carries 2 marks)

1. Evaluate $\lim_{x \to \pi} \frac{cosx}{1-\pi}$
2. Evaluate $\lim_{x \to -1} \frac{x^3+4x^2-3}{x^2+5}$
3. Using the definition of derivatives, find k′(z) if $k(z) = \frac{1-z}{2z}$
4. Find the derivatives of all orders of the function $y = \frac{x^4}{2} - \frac{3}{2}x^2 - x$
5. Define absolute maximum and absolute minimum.
6. If $f(x, y) = x + y$ find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$
7. Find all the first and second order partial derivatives of $f(x, y) = x^2y + y^3$.
8. State chain rule for functions of two independent variables.
9. Write the negation of '$x = 2$ is a solution of $x^2 = 4$'.
10. Check whether the argument $p \to q, q \vdash p$ is a fallacy.
11. Find a counter example for the statement $\{\forall x, x \ is \ prime\}$ where $U = \{3,5,7,9\}$ is the universal set.
12. In a Boolean algebra, show that $a + (a * b) = a$. (10×2=20)

PART B (Short Essay)
(Answer any six questions. Each question carries 5 marks)

13. Find the value of δ in the definition of limit of a function for the given value of ∈ if $f(x) = \sqrt{x-7},\ L = 4,\ x_0 = 23, \in = 1$.
14. Find the horizontal asymptote of the curve $y = \frac{5x^2+8x-3}{3x^2+2}$
15. Find the equation of the tangent line of $y = tanx, -\frac{\pi}{2} < x < \frac{\pi}{2}$ at the points $x = \frac{-\pi}{3}, 0, \frac{\pi}{3}$
16. Find the derivative of the function at each critical point and determine the local extreme values of the function $f(x) = x^{\frac{2}{3}}(x + 2)$.
17. Find the value of $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ at the point $(2, \frac{\pi}{4})$ if $f(x, y) = xysinxy$.
18. Verify that $\frac{\partial^3 u}{\partial y \partial x^2} = \frac{\partial^3 u}{\partial x^2 \partial y}$ where $u = y^2e^x + x^2y^3 + 16$.
19. Find $\frac{\partial z}{\partial x}$ if the equation $\mathrm{yz} - \mathrm{lnz} = \mathrm{x} + \mathrm{y}$, defines z as a function of the two independent variables x and y.
20. Show that the proposition $([p \to q] \wedge [q \to r]) \to [p \to r]$ is a tautology.

21. Check whether $\neg(p \wedge q)$ and $\neg p \vee \neg q$ are logically equivalent. (6×5=30)

PART C (Long Essay)
(Answer any two questions. Each question carries 15 marks)

22. a) If $f(u)$ is differentiable at the point $u = g(x)$ and g(x) is differentiable at x then prove that (*fog*) (*x)* is differentiable at x and $(fog)'(x) = f'(g(x)).g'(x)$.
    b) Find a parametrization for the line segment with end points $(-2,1)$ and $(3,5)$.
    c) If $xy + y^2 = 1$. Find the value of $\frac{d^2y}{dx^2}$ at the point (0, -1).
23. a) Show that the functions $f(x) = x^4 + 3x + 1$ have exactly one zero in the interval $[-2,-1]$.
    b) Find the function with the derivative $f'(x) = 2x - 1$ which passes through the point P(0,0).
    c) The acceleration $a(t) = 32$, initial velocity $v(0) = 20$, initial position $s(0) = 5$. Find the body's position at time t.
24. a) Find the critical points of $f(x) = x^4 - 8x^2 + 16$ and identify the intervals on which f is increasing and decreasing. Also find the functions local and absolute extrema.
    b) Suppose that f is continuous on $[a, b]$ and differentiable on (a, b). If $f'(x) > 0$ at each point $x \in (a, b)$ then prove that f is increasing on [a, b] and if $f'(x) < 0$ at each point $x \in (a, b)$ then prove that f is decreasing on [a, b].
    c) State first derivative test for local extrema.
25. a) Using Chain rule find $\frac{\partial w}{\partial u}$ and $\frac{\partial w}{\partial v}$ if $w = xy + yz + xz, x = u + v, y = u - v, z = uv$
    b) Find $\frac{dw}{dt}$ using Chain rule when $w = \frac{x}{z} + \frac{y}{z}, x = cos^2t, y = sin^2t, z = \frac{1}{t}$
    c) The plane $x = 2$ intersect the paraboloid $z = x^2 + y^2$ in a parabola. Find the slope of the tangent to the parabola at (2, 3, 13).

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Second Semester
Programme: Mathematics

Core Course – UG21MT2CR01 – ANALYTIC GEOMETRY, TRIGONOMETRY AND PARTIAL DIFFERENTIATION

Time: 3 hrs. Max Marks:

80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Find the condition for $lx + my + n = 0$ to be a tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$.
2. Define orthoptic locus.
3. Write the equation of the tangent at the point (x_1, y_1) on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.
4. Find the condition for the lines $lx + my + n = 0$ and $l'x + m'y + n' = 0$ to be conjugate with respect to the parabola $y^2 = 4ax$.
5. Define conjugate diameters of ellipse. What is the condition for the lines $y = mx$ and $y = m'x$ to be conjugate diameters of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.
6. Write the formula for finding the area of a triangle whose vertices are (r_1, θ_1), (r_2, θ_2) and (r_3, θ_3) given in polar co-ordinates.
7. Write the equation of the line perpendicular to $p = r cos(\theta - \alpha)$.
8. Prove that $cosx$ is a periodic function and find the period of $sinx$.
9. Find $\frac{\partial u}{\partial r}, \frac{\partial u}{\partial \theta}$ where $u = x^2 + y^2, x = rcos\theta, y = rsin\theta$.
10. Using partial derivatives find $\frac{dy}{dx}$ at $(0, \ln 2)$ if $xe^y + sinxy + y - ln2 = 0$.
11. Find the critical point of $f(x, y) = xy - x^2 - y^2 - 2x - 2y + 4$.
12. Describe the method Lagrange's multipliers. (10×2=20)

PART B

(Answer any six questions. Each question carries 5 marks)

13. Prove that the tangents at the extremities of any focal chord of a parabola intersect at right angles on the directrix.
14. Find the locus of middle points of a system of parallel chords of the parabola $y^2 = 4ax$.
15. Show that the tangents at the extremities of a diameter of an ellipse are parallel to the diameter conjugate to it.
16. Find the equation of the tangent at a point on the conic $\frac{l}{r} = 1 + ecos\theta$, whose vectorial angle is α.
17. If $\cosh(u + iv) = x + iy$ then prove that $\frac{x^2}{cos^2 u} - \frac{y^2}{sin^2 u} = 1$.
18. Factorise $x^7 - 1$ into real factors.
19. Does the existence of partial derivatives of a function at a point in the domain imply the continuity of the function at that point? Justify.
20. Find $\frac{dw}{dt}$ using chain rule for $w = 2ye^x - lnz$ where $x = ln(t^2 + 1), y = tan^{-1}t, z = e^t$. Also find its value at $t = 1$.

21. Find the absolute maximum and minimum values for the function $f(x,y) = 2 + 2x + 2y - x^2 - y^2$ on the triangular region in the first quadrant bounded by the lines $x = 0,\ y = 0\ and\ y = 9 - x$.

(6×5=30)

PART C

(Answer any two questions. Each question carries 15 marks)

22. a) Show that the locus of the midpoints of chords of a parabola which subtend a right angle at the vertex is another parabola of half the latus rectum of the original parabola.
    b) If P and D are the extremities of conjugate diameters of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1.$ Show that the locus of the midpoint of PD is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = \frac{1}{2}$.
23. a) Find the equation of the polar of the point $(r_1,\ \theta_1)$ with respect to the conic $\frac{l}{r} = 1 + ecos\theta.$
    b) A circle passing through the focus of a conic whose latus rectum is $2l$ meets the conic in four points whose distances from the focus are r_1, r_2, r_3, r_4. Prove that $\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \frac{1}{r_4} = \frac{2}{l}$.
24. Sum the series $\frac{1}{2}\ sinx + \frac{1.3}{2.4}\ sin2x + \frac{1.3.5}{2.4.6}\ sin3x + \cdots$
25. Find the points on the sphere $x^2 + y^2 + z^2 = 25$ where $f\ (x,y,z) = x + 2y + 3z$ has its maximum and minimum values.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Second Semester

Complementary Course – UG21MT2CM01 – INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

(Complementary Mathematics for B.Sc. Physics/Chemistry)

Time: 3 hrs. Max. Marks: 80

PART A

(Answer any ten questions. Each question carries 2 marks)

1. Evaluate $\int_{-\sqrt{3}}^{\sqrt{3}} \frac{4x}{\sqrt{x^2+1}}\ dx.$

2. Find the area bounded by the curves $y = \sqrt{x}, y = 0$ and $x = 4$.
3. Find the length of the circle of radius r defined parametrically by $x = r\,cost$ and $y = r\,sint$, $0 \le t \le 2\pi$.
4. Find the length of the curve defined by $y = x^{3/2}$ from $x = 0$ to $x = 4$.
5. Find the area of the region R bounded by the coordinate axis and the line $x + y = 2$.
6. Find the average value of $\mathrm{f(x, y) = sin(x + y)}$ over the rectangle $0 \le x \le \pi, 0 \le y \le \pi$.
7. Evaluate the integral $\int_0^2 \int_0^2 \int_0^2 dzdxdy$.
8. Solve the differential equation $\frac{x^2}{y}\, dy + 2xdx = 0$.
9. Solve the differential equation $\frac{dy}{dx} = 8y$.
10. Solve $\frac{dy}{dx} = \frac{x}{y}$.
11. Distinguish between ordinary differential equation and partial differential equation.
12. Eliminate the arbitrary function f from the equation $z = x + y + f(xy)$. (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Find the area enclosed by $x = y^2$ and $x = y + 2$.
14. Evaluate the integral $\int_{\pi}^{2\pi} \int_0^{\pi} (sinx + cosy)dxdy$.
15. Solve the differential equation $\frac{dP}{dt} = P - P^2$.
16. Find the volume of the solid generated by revolving the region bounded by $y = \sqrt{x}$ and the lines $y = 1, x = 4$ about the line $x = 4$.
17. Find the area of the surface generated by revolving the curve $y = 2\sqrt{x}, 1 \le x \le 2$ about the x-axis.
18. Sketch the region of integration for the integral $\int_0^b \int_0^{\frac{a}{b}\sqrt{b^2-y^2}} xydxdy$ and write down an equivalent integral with the order of integration reversed.
19. Change the Cartesian integral into an equivalent polar integral then evaluate the polar integral $\int_{-1}^{1} \int_0^{\sqrt{1-x^2}} dydx$.
20. Solve the homogeneous equation $\mathrm{ydx - 2(x + y)dy = 0}$.
21. Solve the differential equation $(x^2 - 4xy - 2y^2)dx + (y^2 - 4xy - 2x^2)dy = 0$.
(6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. a) Evaluate $\int_0^{\pi/6}(1 - cos3t)sin3tdt$.
    b) The line segment $x = 1 - y, 0 \leq y \leq 1$ is revolved about the y-axis to generate a cone. Find its lateral surface area.
    c) Find the volume of the solids of revolution of the region bounded by the line $y = 0$ and curves $y = x - x^2$ about the x-axis.
23. Find the center of mass of a thin plate of density $\delta = 3$ bounded by the lines $x = 0$, $y = x$ and the parabola $y = 2 - x^2$ in the first quadrant.
24. a) Solve $\frac{dy}{dx} + \frac{y}{x} = 12y^3, y(1) = 4$.
    b) Solve $3e^x tanydx + (1 + e^x)sec^2 ydy = 0$ give $y = \frac{\pi}{4}, x = 0$.
25. a) Solve $(y^2 + z^2)p - xyq = -zx$.
    b) Find the integral surface of the $(x - y)y^2p + (y - x)x^2q = (x^2 + y^2)z$ through the curve $xy = a^3, y = 0$.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Second Semester

Complementary Course – UG21MT2CM02 – INTEGRAL CALCULUS AND TRIGONOMETRY

(Complementary Mathematics for B.Sc. Statistics)

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Express the sum $1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5}$ in sigma notation.
2. Write the sum of first n cubes.

3. Evaluate
$$\sum_{k=1}^{4} \cos k\pi$$
4. Find the length of the circle of radius r defined parametrically by $x = r\, cost$, $y = r\, sint, 0 \leq t \leq 2\pi$.
5. Find the area of the surface generated by revolving the curve $y = x, 0 \leq x \leq 1$ about the x-axis.
6. Evaluate $\int \frac{16x}{\sqrt{8x^2+1}}\, dx$
7. Evaluate $\int_1^2 xlogxdx$.
8. Evaluate $\int_0^{\pi/2} sin^7 xdx$.
9. Express $1 + i$ in modulus amplitude form.
10. State Eulers formula and express $sinx$ and $cosx$ in exponential form.
11. Find the real and imaginary parts of $cosec(\alpha + i\beta)$.
12. Show that $cosh^{-1}x = \log x + \sqrt{x^2 - 1}.$ (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Find $\frac{dy}{dx}\ if\ y = \int_1^{x^2} cost\ dt$.
14. Find $\int cos^2 xdx$
15. Find the volume of the solid generated by revolving the region bounded by $y = \sqrt{x}$ and the lines $y = 1,\ x = 4$ about the line $y = 1$.
16. Find the length of the curve $= \int_0^y \sqrt{sec^4 t - 1}\ dt, \frac{-\pi}{4} \leq y \leq \frac{\pi}{4}$.
17. Evaluate $\int_{\pi/2}^{\pi} \sqrt{1 + cos2t}\, dt$.
18. Evaluate $\int \frac{-2x+4}{(x^2+1)(x-1)^2}\, dx$.
19. Evaluate $\int \frac{x^3}{\sqrt{1-x^2}}\, dx$.
20. Solve the equation $x^9 - x^5 + x^4 - 1 = 0$.
21. Separate into real and imaginary parts $tan^{-1}(cos\theta + i\, sin\theta)$. (6×5=30)

PART C

(Answer any two questions. Each question carries 15 marks)

22. a) Let f be continuous on the symmetric interval $[-a,\ a]$ (i) If f is even then show that $\int_{-a}^{a} f(x)dx = 2\int_{0}^{a} f(x)dx$ (ii) If f is odd then show that $\int_{-a}^{a} f(x)dx = 0$.
    b) Evaluate $\int_{-2}^{2}(x^4 - 4x^2 + 6)dx$.
23. a) Find the length of the curve $y = \frac{x^3}{3} + x^2 + x + \frac{1}{(4x+4)}, 0 \leq x \leq 2$.
    b) Find the area of the surface generated by revolving the curve $y = \sqrt{x+1}, 1 \leq x \leq 5$ about the x-axis.
24. a) Evaluate $\int \frac{dx}{\sqrt{25x^2-4}}; x > \frac{2}{5}$.
    b) Find the volume of the solid generated by revolving the region in the first quadrant enclosed by the co-ordinate axes, the curve $y = \frac{2}{1+x^2}$ and the line $x = 1$ about the x-axis.
25. a) Find the sum of the series $\sin\beta - \frac{\sin(2\alpha+\beta)}{2!} + \frac{\sin(4\alpha+\beta)}{4!} + \cdots$
    b) Separate in to real and imaginary parts $\tanh(\alpha + i\beta)$.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Third Semester

Programme: Mathematics

Core Course – UG21MT3CR01 – CALCULUS

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. If $x = a(cos\theta + \theta sin\theta)$ and $y = a(sin\theta - \theta cos\theta)$ find $\frac{dy}{dx}$.
2. Find the *n^th^* derivative $e^{ax} sin\ (bx + c)$.
3. State Leibnitz's theorem.

4. Expand log $(x + a)$ by Taylor's theorem.
5. Find the interval where the curve $y = e^x$ is concave upward.
6. Find $\frac{ds}{dt}$ for the curve $y = cosh\frac{x}{c}$.
7. Find ρ at the origin of $2x^4 + 3y^4 + 4x^2y + xy - y^2 + 2x = 0$.
8. Write Shell formula.
9. Write the formula for finding the length of a curve in parametric form.
10. Find the surface area of the torus generated by revolving a circular disk of radius a about an axis in its plane at a distance $b \geq a$ from its center.
11. State first form of Fubini's Theorem.
12. Sketch the region bounded by $y = x, y = x^2$ and express the region's area as an iterated double integral.

(10×2=20)

PART B

(Answer any six questions. Each question carries 5 marks)

13. If $y = acos(logx) + bsin(logx)$ show that $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$.
14. Determine $lim_{x\to a}(2 - \frac{x}{a})^{tan\frac{\pi x}{2a}}$.
15. Expand $2x^3 + 7x^2 + x - 6$ in powers of $(x - 2)$.
16. Apply Newton's formula to find the radius of curvature at the origin of the cycloid $x = a(\theta + sin\theta),\ y = a(1 - cos\theta)$.
17. Find the volume of the solid generated by revolving the region between the parabola $x = y^2 + 1$, and the line $x = 3$ about the line $x = 3$.
18. The region bounded by the curve $y = x^2 + 1$ and the line $y = -x + 3$ is revolved about the x-axis to generate a solid. Find the volume of the solid.
19. The line segment $x = 1 - y; 0 \leq y \leq 1$ is revolved about the y-axis to generate a cone. Find its lateral surface area.
20. Change the Cartesian integral into an equivalent polar integral $\int_{-1}^{1}\int_{0}^{\sqrt{1-x^2}} dydx$. Then evaluate the polar integral.
21. Evaluate $\int_0^{\pi}\int_0^{\pi}\int_0^{2sin\phi} \rho^2 sin\phi\ d\rho\ d\phi\ d\theta$. (6×5=30)

PART C

(Answer any two questions. Each question carries 15 marks)

22. By finding in two different ways the n^{th} derivative of x^{2n} prove that
$$1+\frac{n^2}{1^2}+\frac{n^2(n-1)^2}{1^2 2^2}+\frac{n^2(n-1)^2(n-2)^2}{1^2 2^2 3^2}+\cdots=\frac{2n!}{(n!)^2}$$
23. Find the asymptotes of the curve $x^3+4x^2y+4xy^2+5x^2+15xy+10y^2-2y+1=0$.
24. a) Find the volume of the solid generated by revolving the region bounded by $y=\sqrt{x}$ and the lines $y=1, x=4$ about the line $y=1$.
    b) Find the area of the surface generated by revolving the curve $y=x^3, 0\le x\le 1/2$ about the x-axis.
25. Apply a transformation to integrate $\int_0^1\int_0^{1-x}\sqrt{x+y}\,(y-2x)^2dydx$.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Third Semester

Complementary Course – UG21MT3CM01 – VECTORS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA

(Complementary Mathematics for B.Sc. Physics/Chemistry)

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. If $r(t)=(cost)\mathbf{i}+(sint)\mathbf{j}+t\mathbf{k}$ find the velocity vector.
2. Find the length of the indicated portion of the curve $r(t)=(1+2t)\mathbf{i}+(1+3t)\mathbf{j}+(6-6t)\mathbf{k}\,;\ -1\le t\le 0$.
3. Find the principal normal vector N of the helix $r(t)=(acost)\mathbf{i}+(asint)\mathbf{j}+b\mathbf{k}\,; a,b\ge$

$0\,;\ a^2 + b^2 \neq 0$.

4. Prove or disprove that $\mathbf{F} = (y\,sin\,z)\mathbf{i} + (x\sin z)\mathbf{j} + (xy\cos z)\mathbf{k}$ independent of path in any domain in space.
5. Compute the divergence of $\mathbf{F} = z^2(y - x)\mathbf{i} + \frac{4y^2}{z^3}\mathbf{j} + (x^2 - 3z)\mathbf{k}$.
6. If $\mathbf{r} = x\,\mathbf{i} + y\,\mathbf{j} + z\,k$, then prove that div $\mathbf{r} = 3$.
7. Find the eccentricity of the ellipse $9x^2 + 10y^2 = 90$.
8. Find the asymptotes of the hyperbola $\frac{y^2}{4} - \frac{x^2}{5} = 1$.
9. Write the equation of the ellipse with foci $(0, \pm 3)$ and eccentricity 0.5.
10. Let $*$ be defined on $\mathbb{Q}$ by letting $a * b = \frac{ab}{2}$. Determine whether $*$ is a binary operation on $\mathbb{Q}$.
11. Is the set of $n \times n$ matrices with determinant -1 a subgroup of the set of all $n \times n$ invertible matrices under multiplication?
12. Find all the generators of the group $\mathbb{Z}_{13}$ under addition modulo 13. (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Find the surface area of a sphere of radius a.
14. Sketch the parabola $y^2 = -2x$.
15. Find the equation of the circle of curvature of the curve $r(t) = t\mathbf{i} + sint\,\mathbf{j}$ at the point $\left(\frac{\pi}{2}, 1\right)$.
16. Find the torsion τ for the space curve $r(t) = \frac{t^3}{3}\,\mathbf{i} + \frac{t^2}{2}\,\mathbf{j}$ where $t > 0$.
17. Integrate $f(x, y, z) = x + \sqrt{y} - z^2$ over the path from (0, 0, 0) to (1, 1, 1) given by
    a) $C_1 : r(t) = t\mathbf{i} + t^2\mathbf{j}; 0 \leq t \leq 1$
    b) $C_2 : r(t) = \mathbf{i} + \mathbf{j} + t\mathbf{k}; 0 \leq t \leq 1$
18. Show that the differential form under the integral sign of $I = \int_C [2xyz^2dx + (x^2z^2 + z\cos(yz))dy + (2x^2yz + y\cos(yz))dz]$ is exact. Find the value of I from (0,0,1) to (1, π/4,2).
19. Write the equation of the ellipse of eccentricity 0.8 whose focii lie at the point (0, ±7). Also sketch the ellipse.
20. Let $U_n = \{z \in \mathbb{C} | z^n = 1\}$ be the set of n^{th} roots of unity. Show that U_n is an abelian group with respect to multiplication of complex numbers.
21. Consider the permutation $\mu = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 3 & 8 & 6 & 7 & 4 & 1 & 5 & 2 \end{pmatrix}$.
    a) Express σ as a product of disjoint cycles.
    b) Write σ as a product of transpositions.

c) Compute σ^2.
d) Find whether σ is odd or even permutation.
e) What is the order of σ ? (6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. Find T, N and κ for the curve $r(t) = (tcost)\mathbf{i} + (tsint)\mathbf{j} + t\mathbf{k}$ when $t = \sqrt{3}$.
23. Verify Divergence theorem for the field $\mathbf{F} = 2xz\ \mathbf{i} + yz\ \mathbf{j} + z^2\ \mathbf{k}$, over the half sphere $x^2 + y^2 + z^2 = a^2$ lying above the x-y plane.
24. a) Sketch the conic $r = \frac{6}{2+cos\theta}$.
    b) Find a polar equation of the curve whose Cartesian equation is $x^2 + y^2 - 3x = 0$.
25. Define a ring. Prove that the set $M_n(\mathbb{Z})$ of all $n \times n$ matrices with integer entries is a non-commutative ring with unity.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Third Semester

Complementary Course – UG21MT3CM02 – VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM

(Complementary Mathematics for B.Sc. Statistics)

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Let $\vec{v} = \overrightarrow{PQ}$ where $P = (5,4,7), Q = (9,8,2)$. Find $|\vec{v}|$.
2. Find the resultant of the vectors $\vec{u} = [4, -2, 3], \vec{v} = [8, 8, 1], \vec{w} = [-12, -6, 2]$. Also find its magnitude.

3. Find the gradient of $f(x,y,z) = (x^2 + y^2 + z^2)^{\frac{1}{2}}$ at $P(2,1,3)$.
4. Find the divergence of $\vec{v} = e^x\,\hat{\imath} + ye^{-x}\,\hat{\jmath} + 2zsinhx\hat{k}$.
5. Find the degree and order of the differential equation $\frac{d^2y}{dx^2} + 2(\frac{dy}{dx})^2 + y = 0$.
6. Solve $(1 + x)dy - ydx = 0$.
7. Solve $x\frac{dy}{dx} = y(logy - logx + 1)$.
8. Write the general form of linear differential equation with an example.
9. Form the partial differential equation corresponding to $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$
10. Form the partial differential equation corresponding to $z = f(x^2 - y^2)$.
11. Define L[f(t)]. Find L[t].
12. Write the inverse Laplace transform of $\left(\frac{1-\sqrt{s}}{s^2}\right)^2$. (10×2=20)

PART B

(Answer any six questions. Each question carries 5 marks)

13. Find the angle between the lines $x - y = 1$ and $x - 2y = -1$.
14. Find the parametric equation of the straight line through the points $A(2,3,0)$ and $B(5,-1,0)$.
15. Solve $(x + 2y + 3)dx - (2x - y + 1)dy = 0$.
16. A force $\vec{p} = [0, 0, 10]$ acts on a line through a point $Q = (2,2,0)$. Find the moment vector $\vec{m}$ of $\vec{P}$ about a point $A = (0,0,0)$.
17. Solve $\left(\frac{e^{-2\sqrt{x}}}{\sqrt{x}} - \frac{y}{\sqrt{x}}\right)\frac{dx}{dy} = 1$.
18. Solve $\frac{dy}{dx} - x^2y = y^2e^{\frac{-1}{3}x^3}$.
19. Form the partial differential equation by eliminating the functions from the expression $z = f(x + ay) + g(x - ay)$.
20. Find the integral curves of the partial differential equation $z(xp - yq) = y^2 - x^2$.
21. Find the inverse Laplace transform of $\frac{21s-33}{(s+1)(s-2)^3}$. (6×5=30)

PART C

(Answer any two questions. Each question carries 15 marks)

22. a) Find the unit normal vector $\hat{n}$ of the cone of revolution $z^2 = 4(x^2 + y^2)$ at the

point $P(1,0,2)$.

b) Find the potential function of the vector function $\vec{v} = [ye^x,\ e^x, 1]$.

c) For any twice differentiable scalar function f, show that $curl(grad\ f) = 0$.

23. a) Solve $x\frac{dy}{dx} + y = e^x - xy$.

b) Solve $\left(y^2e^{xy^2} + 4x^3\right)dx + (2xye^{xy} - 3y^2)dy = 0$.

24. a) Find the partial differential equation of concentric spheres whose centre is on the z-axis.

b) Find the integral curves of the equation $x^2(y - z)p + y^2(z - x)q = z^2(x - y)$.

25. a) Find the Laplace transform of $sin2tsin3t$.

b) Find the inverse Laplace transform of $\frac{s}{(s^4+4a^4)}$.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fourth Semester

Programme: Mathematics

Core Course – UG21MT4CR01 – VECTOR CALCULUS, THEORY OF EQUATIONS AND NUMERICAL METHODS

Time: 3 hrs. Max. Marks: 80

PART A

(Answer any ten questions. Each question carries 2 marks)

1. Find parametric equation for the line through point $P(3, -2,1)$ and parallel to the line $x = 1 + 2t,\ y = 2 - t,\ z = 3t$
2. Find the unit tangent vector of the curve $r(t) = (t\ sin\ t + cos\ t)i + (t\ cos\ t - sin\ t)j$.

3. Find the directional derivative of $f(x,y) = x^2 + xy$ at the point $P_0(1,2)$ in the direction of a unit vector $\hat{u} = \frac{1}{\sqrt{2}}i + \frac{1}{\sqrt{2}}j$.
4. Find linearization of $f(x,y) = x^2 - xy + \frac{y^2}{2} + 3$ at the point (3, 2).
5. Evaluate $\int_C (xy + y + z)ds$ along the curve $r(t) = 2ti + tj + (2 + 2t)k, 0 \leq t \leq 1$.
6. If $F = (2xy^3)i + (4x^2y^2)j$. Find Divergence and $k-$ component of Curl of F.
7. Apply Green's theorem to evaluate the line integral $\oint_C (xydy - y^2dx)$, where C is the square cut from the first quadrant by the lines $x = 1, y = 1$.
8. State Stoke's theorem and Divergence theorem.
9. Without actual division show that $(x-1)^{2n} - x^{2n} + 2x - 1$ is divisible by $2x^3 - 3x^2 + x$.
10. Find the equation whose roots exceed by 2 the roots of equation $4x^4 + 32x^3 + 83x^2 + 76x + 21 = 0$.
11. If α, β, γ are the roots of the cubic $x^3 - x^2 + x - 2 = 0$ find the value of $\sum\alpha^2$.
12. State a formula to find the positive cube root of a natural number N.

(10×2=20)

PART B

(Answer any six questions. Each question carries 5 marks)

13. If $r(t) = 3\cos\ ti + 3\sin\ tj + t^2k$ is the position vector of a particle. Find its velocity, speed and acceleration vectors. Also find the time when velocity and acceleration vectors are orthogonal in the time interval $0 \leq t \leq 4\pi$.
14. Find K and τ for the helix $r(t) = (a\cos\ t)j + (a\sin\ t)j + btk, a, b > 0; a^2 + b^2 \neq 0$.
15. Find a potential function f for the field $F = 2xi + 3yj + 4zk$.
16. Find the area of the cup cut from the hemisphere $x^2 + y^2 + z^2 = 2, z \geq 0$, by the cylinder $x^2 + y^2 = 1$.
17. Given that the equation $x^4 - 14x^3 + 73x^2 - 168x + 144 = 0$ has two pairs of equal roots. Find them.
18. State the Descartes rule of signs and use it to show that $x^9 - x^5 + x^4 + x^2 + 1 = 0$ has atleast 6 imaginary roots.
19. Solve using Cardon's method $x^3 - 6x - 9 = 0$.
20. Find the first three approximations for the root of $x^3 - 2x - 5 = 0$ using false position method.
21. Use bisection method to find a root for $x^3 - 18 = 0$. (6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. Integrate $g(x, y, z) = x + y + z$ over the surface of the cube cut from the first octant by the planes $x = a,\ y = a,\ z = a$.
23. a) Calculate the flux and the circulation of the vector field $F = -yi + xj$ around the closed semi-circular path that consists of the semi-circular arch $r_1(t) = (a\,cos\ t)i + (a\,sin\ t)j: 0 \le t \le \pi$ followed by the line segment $r_2(t) = ti: -a \le t \le a$.
    b) Find the centre of mass of a thin hemispherical shell $f(x,\ y,\ z) = x^2 + y^2 + z^2 = a^2$, $z \ge 0$ of radius $'a'$ and constant density δ.
24. a) Solve $x^4 - 3x^2 - 42x - 40 = 0$ using Ferrari method.
    b) Use Descartes method to solve $x^4 - 2x^2 + 8x - 3 = 0$.
25. Find a real root of $x^3 + x + 1 = 0$ using Regula-falsi method. (2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fourth Semester

Complementary Course – UG21MT4CM01 – FOURIER SERIES, LAPLACE TRANSFORM AND LINEAR ALGEBRA

(Complementary Mathematics for B.Sc. Physics/Chemistry)

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Define Periodic function. Give an example for a periodic function.
2. Define Odd and function. Check whether the function $x + x^2$ is even or odd.
3. Write the Fourier series expansion of an odd function $f(x)$ of period $2L$. Also write the fourier coefficients.

4. Define the Inverse Laplace Transform of a function. Write the Inverse Laplace Transform of $\frac{1}{s+5}$.
5. Find $L[5e^t]$ using Shifting Theorem.
6. Find $L[1]$.
7. Find $L[t^{-\frac{1}{2}}]$.
8. Define linear independence of vectors.
9. Determine whether $B = \{[1\ \ 1], [1 - 1]\}$ is a basis of R^2.
10. Find the rank of the given matrix $\begin{pmatrix} 1 & 2 & 0 \\ 3 & 1 & -5 \end{pmatrix}$.
11. Determine whether the transformation $T: V \longrightarrow V$ defined by $T(v) = kv$ for all vectors v in V and any scalar k is linear.
12. Prove that if matrix A is similar to matrix B then matrix B is similar to matrix A.

(10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Find the Fourier series expansion of the function $f\ (x) = \begin{cases} 0 & if \ -2 \le x < -1 \\ k & if \ -1 \le x < 1 \\ 0 & if \ \ 1 \le x \le 2 \end{cases}$ of period $p = 4$.
14. Solve the equation $y' = xy$ by power series method.
15. Verify that the function $P_3(x) = \frac{1}{2}(5x^3 - 3x)$ satisfy Legendre's equation.
16. Find the Laplace transform of $F(t) = coshat$ using linearity Property.
17. Find $L[t^{n+1}]$ where n is an integer.
18. Prove that for any vector w in a vector space V, $-1 \odot w = -w$.
19. Determine whether $\left\{\begin{bmatrix} a & b \\ c & d \end{bmatrix} \in M_{2\times2} / b = c = 0\right\}$ is a vector space under standard matrix and scalar multiplication.
20. Find the matrix representation for the linear transformation $T: M_{2\times2} \longrightarrow M_{2\times2}$ defined by $T\ \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} a + 2b + 3c & 2b - 3c + 4d \\ 3a - 4b - 5d & 0 \end{pmatrix}$ with respect to the standard basis $B = \left\{\begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}, \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}\right\}$.
21. Find the kernel and the image of the linear transformation $T: P^2 \longrightarrow M_{2\times2}$ defined by $T(at^2 +$

$bt + c) = \begin{pmatrix} a & 2b \\ 0 & a \end{pmatrix}$.

(6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. a) Find the fourier cosine series expansion of the function $f(x) = x^3 \;\; 0 < x < L$.
    b) Find the fourier sine series expansion of the function $f(x) = \pi - x \;\; 0 \le x \le \pi$.
23. a) Find $L^{-1}\left[\frac{1}{s^2+4s}\right]$.
    b) Find $L[coshatsint]$.
24. a) Determine the consistency of the system of equations and find the solution
    $x - y + 2z = 0$
    $2x - 3y + 5z = 0$
    $-2x + 7y - 9z = 0$
    b) Find the transition matrix between bases $C = \{[1 \;\; 0], [0 \;\; 1]\}$ and $D = \{[1 \;\; 1], [1 - 1]\}$ in R^2.
25. a) Determine the consistency of the system of equations and find the solution
    $x - y + 2z = 0$
    $2x + 3y - z = 0$
    $-2x + 7y - 7z = 0$
    b) If T is a linear transformation form an n −dimensional vector space V into W and let $\{v_1, v_2, \ldots v_k\}$ is a basis for the kernel of T. If this basis is extended to a basis $\{v_1, v_2, \ldots v_k, v_{k+1}, \ldots v_n\}$ for V then prove that $\{T(v_1), T(v_2), \ldots T(v_n)\}$ is a basis for the image of T.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fourth Semester

Complementary Course – UG21MT4CM02 – LINEAR ALGEBRA, THEORY OF EQUATIONS, NUMERICAL METHODS AND SPECIAL FUNCTIONS

(Complementary Mathematics for B.Sc. Statistics)

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Define Inner Products of vectors. Find the inner product of $a = [4 \quad -1 \quad 5]$ and $b = [2 \quad 5 \quad 8]^T$.
2. Solve the system $\begin{matrix} 6x + 4y = 2 \\ 3x - 5y = -34 \end{matrix}$, by Gauss Elimination.

3. Define a Skew-symmetric matrix and show that the main diagonal entries of a skew-symmetric matrix are zero.
4. State the division algorithm for polynomials.
5. Given -4 is a root of $2x^3 + 6x^2 + 7x + 60 = 0$. Find the other roots.
6. State the Fundamental theorem of algebra.
7. Derive the formula for method of false position.
8. What is the geometrical interpretation of regula falsi method?
9. Derive the formula for Newton Raphson method.
10. Show that $\int_0^1 y^{q-1}\left(log\frac{1}{y}\right)^{p-1} dy = \frac{\Gamma(p)}{q^p}$, where $p > 0, q > 0$.
11. Prove that $\int_0^\infty \sqrt{x}\, e^{-x^3} dx = \frac{\sqrt{\pi}}{3}$.
12. Show that $\int_0^{\pi/2} sin^n x dx = \frac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n+2}{2}\right)} \frac{\sqrt{\pi}}{2}$. (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Find the determinant of the matrix $\begin{bmatrix} 2 & -3 & 1 & 4 \\ 1 & 4 & 5 & -2 \\ 2 & 0 & 1 & 1 \\ 5 & 3 & 2 & 0 \end{bmatrix}$.
14. Test for consistency and solve the system $\begin{array}{c} x + y - z = 9 \\ 8y + 6z = -6 \\ 2x + 4y - 6z = 40 \end{array}$.
15. Using Cayley Hamilton theorem show that $A^3 - 6A^2 + 11A - 6I = 0$ where $A = \begin{bmatrix} 1 & 1 & 2 \\ 0 & 2 & 2 \\ -1 & -1 & 3 \end{bmatrix}$ and hence find A^{-1}.
16. Solve the equation $40x^4 + 22x^3 - 21x^2 - 2x + 1 = 0$ given that the roots are in Harmonic progression.
17. Transform the equation $2x^3 - 9x^2 + 13x - 6 = 0$ in to one in which the second term is missing and hence solve the given equation.
18. Solve using Cardon's method $x^3 - 27x + 54 = 0$.
19. If the equation $x^{2.2} - 69 = 0$ a root between 5 and 8, find it using method of false position.
20. By the method of iteration find a real root of the equation $1 + x^2 = x^3$.

21. Show that $B(p,q) = \int_0^1 \frac{x^{p-1}+x^{q-1}}{(1+x)^{p+q}} dx$. (6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. Find the Characteristic Equation and Eigen values of the matrix $\begin{bmatrix} 3 & 0 & 0 \\ 0 & -8 & 0 \\ 0 & 0 & 4 \end{bmatrix}$. Hence find the Eigen Vectors associated with each Eigen values.

23. a) Solve by Cramer's Rule : $\begin{aligned} x - 3y + z &= 2 \\ 3x + y + z &= 6 \\ 5x + y + 3z &= 3 \end{aligned}$

    b) Find the Rank of the matrix $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$.

24. If α, β, γ are the roots of the equation $x^3 + qx + r = 0$ form an equation whose roots are
    a) $\frac{\beta+\gamma}{\alpha^2}, \frac{\alpha+\gamma}{\beta^2}, \frac{\alpha+\beta}{\gamma^2}$
    b) $\frac{\beta}{\gamma} + \frac{\gamma}{\beta}, \frac{\gamma}{\alpha} + \frac{\alpha}{\gamma}, \frac{\alpha}{\beta} + \frac{\beta}{\alpha}$
    c) $\frac{\beta^2+\gamma^2}{\alpha^2}, \frac{\gamma^2+\alpha^2}{\beta^2}, \frac{\alpha^2+\beta^2}{\gamma^2}$

25. a) Find the real root of the equation $x^3 + x - 1 = 0$ by bisection method.
    b) Write the geometrical interpretation of Newton Raphson method.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

Programme: Mathematics

Core Course – UG21MT5CR01 – MATHEMATICAL ANALYSIS

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Show that the infimum of a set is unique.

2. a) State Archimedean property.
   b) Using this property show that for any $\epsilon > 0$, there exist a positive integer n such that $\frac{1}{n} < \epsilon$.

3. Find the derived set of the following:

i) $A = \{x: 0 < x < 1, x \in \mathbb{Q}\}$
ii) $A = \{1 + \frac{1}{n}: n \in \mathbb{N}\}$

4. Show that the infimum of a bounded set is always a member of the closure $\tilde{S}$ of S.
5. Find the limit superior and limit inferior of the sequence $a_n = 1 + (-1)^n$.
6. Show that $lim_{n\to\infty} \frac{(5n+1)(n-2)}{n(n+5)} = 5$.
7. Define monotonic sequence. Give an example of a monotonic increasing sequence that is bounded.
8. If z is any complex number, then show that
   i) $Im(iz) = Re(z)$
   ii) $Re(iz) = -Im(z)$
9. Write $z = -1 + i\sqrt{3}$ in polar form.
10. Sketch the set of points determined by the condition $|z - 4i| \geq 1$.
11. Evaluate $\int_0^\infty e^{-3t} cos(2t).dt$
12. Find the inverse Laplace transform of $\bar{f}(s) = \frac{1}{s(s^2+1})$. (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Show that every open interval is an open set.
14. Show that the set of all rational numbers is countably infinite.
15. State and Prove density theorem.
16. Show that every Cauchy sequence is bounded. Is the converse true? Justify your answer.
17. State and prove sandwich theorem for sequences.
18. Verify that $\sqrt{2}|z| \geq |Re(z)| + |Im(z)|$, where z is a complex number.
19. Write $(\sqrt{3} + i)^4$ in rectangular form.
20. Find the Laplace transform of $f(t) = (e^{-t}sin(2t) - 2tcos(2t))$.
21. Find the inverse Laplace transform of $\bar{f}(s) = \frac{s}{(s+1)^2(s^2+1)}$. (6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. a) Show that the union of finite number of closed sets is closed. Is arbitrary union of closed

sets closed? Justify your answer.

b) Show that derived set of a set is closed.

23. Prove that $\{r^n\}$converges if and only if $-1 < r \leq 1$.

24. i) Show that a monotonic sequence converges if and only if it is bounded.

ii) Show that the sequence $s_n = \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \cdots \frac{1}{n!} \forall n \in \mathbb{N}$ is convergent.

25. i) Solve $y''(t) + 4y'(t) + 3y(t) = e^{-t}, y(0) = y'(0) = 1$ using Laplace transform.

ii) Show that $L(sin(kt)sinh(kt)) = \frac{2k^2 s}{s^4+4k^4}$

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

Programme: Mathematics

Core Course – UG21MT5CR02 – DIFFERENTIAL EQUATIONS

Time: 3 hrs. Max. Marks: 80

PART A

(Answer any ten questions. Each question carries 2 marks)

1. Find the integrating factor for the differential equation $(x^2 + 1)\frac{dy}{dx} + 2xy = x^2$.
2. Find the integrating factor to transform the differential equation $(1 + xy)ydx + (1 - xy)xdy = 0$ to an exact differential equation.
3. Show that the orthogonal trajectory of $x^2 + y^2 = c^2$ is the family of straight lines $y = kx$.

4. Show that e^x, e^{-x}, e^{2x} are linearly independent solutions of $y''' - 2y'' - y' + 2y = 0$.
5. Show that e^{2x}, e^{3x} are linearly independent solutions of $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = 0$ and write the general solution of the given differential equation.
6. Find the solution of $\frac{d^2y}{dx^2} + 9y = 0$.
7. Find the particular integral of $y'' - 2y' - 3y = 2e^x$.
8. Find the ordinary points of the differential equation $(1 - x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + n(n + 1)y = 0$.
9. Locate and classify the singular points of $(x^4 - 2x^3 + x^2)y'' + 2(x - 1)y' + x^2y = 0$.
10. Form a partial differential by eliminating the arbitrary constants from the equation $ax^2 + by^2 + z^2 = 1$.
11. Form a partial differential by eliminating the arbitrary function from the equation $f(x^2 + y^2 + z^2, z^2 - 2xy) = 0$
12. Solve the partial differential equation $xp + yq = z$. (10×2=20)

PART B

(Answer any six questions. Each question carries 5 marks)

13. Solve the differential equation $\left(\sqrt{x + y} + \sqrt{x - y}\right)dx + \left(\sqrt{x - y} - \sqrt{x + y}\right)dy = 0$.
14. Solve the differential equation $\frac{dr}{d\theta} + rtan\theta = cos\theta$.
15. Solve the differential equation $ydx + (xy^2 + x - y)dy = 0$.
16. Find a family of oblique trajectories that intersect the family of straight lines $y = cx$ at an angle 45°.
17. Find the general solution of the differential equation $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = 4x^2$.
18. Solve the differential equation $x^2\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$.
19. Find the power series solution in powers of x for the differential equation $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$
20. Show that $\frac{d}{dx}(J_p(x)) = \frac{1}{2}(J_{p-1}(x) - J_{p+1}(x))$.
21. Find the general integral of the linear partial differential equation $px(x + y) = qy(x + y) - (x - y)(2x + 2y + z)$.

(6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. a) Find the solution of the differential equation $\frac{dy}{dx} + \frac{y}{2x} = \frac{x}{y^3}$ with initial values $y(1) = 2$.
    b) Solve the initial value problem $(x^2 + y^2)dx - 2xydy = 0, y(1) = 2$.
23. Solve the differential equation $y'' + y = tanx$.
24. Use Frobenius method to find the power series solution of $2x^2y'' + xy' + (x^2 - 3)y = 0$, near $x = 0$.
25. a) Solve the linear partial differential equation $(z^2 - 2yz - y^2)p + x(y + z)q = x(y - z)$
    b) Find the general integral of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = xyz$.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

Programme: Mathematics

Core Course – UG21MT5CR03 – ABSTRACT ALGEBRA

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Prove that a binary structure $(S,*)$ has atmost one identity element.
2. Let G be a group. For all $a, b \in G$, prove that $(a * b)^{-1} = b^{-1} * a^{-1}$.
3. How many proper subgroups does the Klein-4 group have? Which are they?
4. Find the order of $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 3 & 1 & 2 & 4 \end{pmatrix}$ in S_4.

5. Define the group S_3.
6. Find the order of the coset $5 + \langle 4 \rangle$ in the factor group $Z_{14}/\langle 4 \rangle$.
7. State and prove Lagrange theorem.
8. If ϕ is a homomorphism of a group G into G'. Prove that $\phi(a^{-1}) = (\phi(a))^{-1}$ is the identity element e' in G'.
9. Define automorphism. Give a specific example.
10. If R is a ring with additive identity 0 then for any $a, b \in R$, prove that $0.a = a.0 = 0$.
11. Give an example of an infinite commutative ring without zero divisors which is not a field.
12. Give an example of a ring which is not an integral domain. (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Show that if $(a * b)^2 = a^2 * b^2$; for $a, b \in G$, then $a * b = b * a$.
14. Show that if H and K are subgroups of an abelian group G then $\{hk/\ h \in H\ \ and\ \ k \in K\}$ is a subgroup of G.
15. Find the number of generators of cyclic group having order 5. Give reasons.
16. Find the orbits of the permutation $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 6 & 4 & 1 & 5 & 2 \end{pmatrix}$.
17. Prove that no permutation in S_n can be expressed both as a product of an even number of transpositions and as a product of an odd number of transpositions.
18. Prove that the Kernel of a group homomorphism is normal.
19. Prove that $Z/6Z$ is not a simple group.
20. Let R be a ring and let a be a fixed element of R. Let $I_a = \{x \in R/ax = 0\}$. Show that I_a is a subring of R.
21. If F is a field and if there exists a positive integer m such that $ma = 0$; $\forall a \in F$, then show that m is prime.

(6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. Let S be the set of all real numbers except -1. Define $*$ on S by $a * b = a + b + ab$.
    a) Show that $*$ gives a binary operation on S.

b) Show that $(S,*)$ is a group.
c) Find the solution of the equation $2 * x * 3 = 7$ in S.

23. State and prove Cayleys theorem.

24. Let $\phi: G \longrightarrow G'$ be a group homomorphism and let $H = Ker(\phi)$. Then prove that cosets of H form a factor group G/H where $(aH)(bH) = (abH)$. Also show that the map $\mu: G/H \longrightarrow \phi(G)$ defined by $\mu(aH) = \phi(a)$ is an isomorphism.

25. a) Prove that every finite integral domain is of finite characteristic.
b) If F is a field and if there exists m such that $ma = 0$ is characteristic of F and also prove that $(x + y)^m = x^m + y^m$; $\forall\ x, y \in F$.

(2×15=30)

B.Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

Programme: Mathematics

Core Course – UG21MT5CR04 – HUMAN RIGHTS AND ENVIRONMENTAL MATHEMATICS

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. Define environmental studies.
2. Who is M.S. Swaminathan? What is his contribution to the conservation of biological diversity?
3. Give a note on energy flow in the ecosystem.
4. What is Joint Forest management?

5. What is the Guardian way of life?
6. Compute the sum $\sum_{i=1}^{7} F_i$ where F_i is the i^th^ Fibonacci number.
7. Use the Euclidean algorithm to find the gcd of the integers 2076, 1076.
8. Prove that $\alpha = \frac{1}{\alpha-1}$, were α is the golden ratio.
9. Show that $L_n = F_{n-1} + F_{n+1}$ for $n > 1$. Hence find $lim_{n\to\alpha} \frac{L_n}{F_n}$.
10. Solve the recurrence relation $a_n = ra_{n-1}$ with the initial condition $a_0 = 0$.
11. Give an account of three generations of human rights.
12. Which are the instruments or documents for international human rights? (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Give a note on world food problems.
14. What measures should be taken to prevent water pollution?
15. Which are the mitigation means for floods?
16. What are the causes of water pollution?
17. Verify that $L_n = F_{n-1} + F_{n+1}$ for $n = 4$ and $n = 7$.
18. Use the Euclidean Algorithm to express the gcd of 4076, 1024 as the linear combination of 4076 and 1024.
19. Solve the recurrence relation $L_n = L_{n-1} + L_{n-2}$ where $L_1 = 1,\ L_2 = 3$.
20. Give a brief account of UDHR.
21. Explain the importance of human rights education. (6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. Write an essay on commercial fuel, non-commercial fuel, primary energy resources, secondary energy resources, conventional energy resources, non-conventional energy resources and renewable energy resources.
23. Give an account of pollution of various natural resources.
24. Compute the sum (i) $\sum_{i=1}^{n} F_i$ (ii) $\sum_{i=1}^{n} F_i^2$ where F_i the i^th^ Fibonacci number.
25. Obtain the Binet form for the Fibonacci number F_n using the Fibonacci recurrence relation.

(2×15=30)

B.A./B.Sc./B.Com. DEGREE (CBCS) EXAMINATION

Fifth Semester

Open Course – UG21MT5OC01 – APPLICABLE MATHEMATICS

Time: 3 hrs. Max. Marks: 80

PART A
(Answer any ten questions. Each question carries 2 marks)

1. The LCM and HCF of two numbers are 4125 and 25 respectively. One number is 375. Find by how much is the second number less than the first?
2. Add together $\frac{3}{8}, \frac{9}{10}, \frac{7}{12}$ and $\frac{13}{16}$.
3. If the product of two numbers is 1575 and their quotient is $\frac{9}{7}$. Find the numbers.
4. A box of Alphonso mangoes was purchased by a fruit-seller for Rs.300. However, he had to sell them for Rs.255 because they began to get over ripe. What was the loss percentage?

5. Solve for x: $x^2 - 18x + 45 = 0$.
6. How many numbers between 400 and 1000 can be formed with the digits 0, 2, 3, 4, 5, 6 if no digits is repeated in the same number?
7. Find the value of $sin\ 30^0 cos\ 45^0 - cos\ 30^0 sin\ 45^0$.
8. Find the simple interest and amount when: Principal = Rs.700, Rate = 6% per annum and Time = 6 months.
9. A man walks 22.5 km. in 5 hours. How much he will walk in 4 hours?
10. Find the altitude of a parallelogram whose area is 2.25 m^2 and base is 2.5 m.
11. The sum of two numbers is 35 and their difference is 13. Find the numbers.
12. Write the product rule and quotient rule of differentiation. (10×2=20)

PART B
(Answer any six questions. Each question carries 5 marks)

13. Determine whether the number 8640 is divisible by 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11. Give reason.
14. How many different words can be formed with the letters of the 'MlSSISSIPPI'?
15. A nursery has 5000 plants, 5% of the plants are roses and 1% are mango plants. What is the total number of other plants?
16. The angle of elevation of a ladder leaning against a wall is 30°, and the foot of the ladder is 9.6 m from the wall. Find the length of the ladder.
17. Amith can do a piece of work in 4 days and Sumith can do it in 6 days. How long will they take, if both Amith and Sumith work together?
18. At what rate, percent per annum will a sum treble itself in 16 years?
19. Find the perimeter of a rectangle whose area is 650 cm^2 and its breadth is 13 cm.
20. If $x^2 + \frac{1}{x^2} = 53$, find the value of (a) $x + \frac{1}{x}$ (b) $x - \frac{1}{x}$
21. Differentiate with respect to x, (i) $(4x^3 - 2x + 7)^{10}$ (ii) $e^{2x+3} \cdot sinx$ (6×5=30)

PART C
(Answer any two questions. Each question carries 15 marks)

22. a) Simplify $\left(\frac{81}{16}\right)^{-3/4} \times \left\{\left(\frac{25}{9}\right)^{-3/2} \div \left(\frac{5}{2}\right)^{-3}\right\}$.
    b) Find the product $\left(1 - \frac{1}{x}\right)\left(x + \frac{1}{x}\right)\left(x^2 + \frac{1}{x^2}\right)\left(x^4 + \frac{1}{x^4}\right)$.
    c) A shopkeeper offers 5% discount on all his goods to all his customers. He offers a further

discount of 2% on the reduced price to those customers who pay cash. What will you actually have to pay for an article in cash if its Marked price is Rs.4800?

23. i) Solve: $(5x + 2)(3x - 1) = -2(x - 3)$.
    ii) The shadow of a flagstaff is three times as long as the shadow of the flagstaff when the sun rays meet the ground at an angle of 60°. Find the angle between the sun rays and the ground at the time of the long shadow.
    iii) A box contains 5 different red and 6 different white balls. In how many ways can 6 balls be selected so that there are at least two balls of each color?

24. i) How much time will a train, 171 meters long, take to cross a bridge, 229 meters long, if it is running at a speed of 45 km/hr?
    ii) Find the sum of $x + \frac{(1+2)x^2}{2!} + \frac{(1+2+3)x^3}{3!} + \cdots$

25. i) Find the derivative of (a) $\sqrt{x^2 + 1}$ (b) $(ax + b)^n(cx + d)^n$
    ii) Solve $\frac{x^2+5x+4}{x^2+3x+2} = \frac{3}{2}; x \neq -1, -2$.
    iii) The area of a right-angled triangle is 600 sq.cm. If the base of the triangle exceeds the altitude by 10 cm, find the dimensions of the triangle.

(2×15=30)