ASSUMPTION COLLEGE

AUTONOMOUS

CHANGANACHERRY

Reaccredited by NAAC with 'A' Grade
Affiliated to Mahatma Gandhi University
Kottayam

CURRICULUM FOR UNDER GRADUATE PROGRAMME

IN

MATHEMATICS

Under Choice Based Credit System (CBCS)

(2017 Admission onwards)

ASSUMPTION COLLEGE AUTONOMOUS, CHANGANASSERY
BOARD OF STUDIES IN MATHEMATICS

1. **Dr M P Rajan** — **Chairman**
   Associate Professor
   Department of Mathematics
   IISER, Thiruvananthapuram

2. **University Nominee**

3. **Dr Sunil C Mathew** — **Subject Expert**
   Associate Professor
   Department of Mathematics
   St. Thomas College, Pala

4. **Dr Varghese C Joshua** — **Subject Expert**
   Associate Professor
   Department of Mathematics
   CMS Autonomous College,
   Kottayam

5. **Dr K M Kurian (Statistics)** — **Subject Expert**
   Associate Professor
   Department of Statistics
   St. Thomas College, Pala

6. **Ms Rosamma V A** — **Member**
   Associate Professor
   Department of Mathematics
   Assumption College Autonomous
   Changanacherry

7. **Dr Sunil Jacob John** — **Member**
   Associate Professor
   Department of Mathematics
   NIT Calicut

8. **Dr Antony Mathews** — **Member**
   Associate Professor
   Department of Mathematics
   SB Autonomous College
   Changanacherry

9. **Dr Aparna Lakshmanan S** **Member**
Assistant Professor
Department of Mathematics
St.Xavier's College for Women,
Aluva

10. **Dr Jikcey Isaac (Statistics)** **Member**
Assistant Professor
Department of Mathematics
Assumption College Autonomous
Changanacherry

11. **Mr. Sibi Chandy** **Industry**
Deputy General Manager
State Bank of Hyderabad
Visakapattanam Zone
LIC Building
Jeevan Prakash Road
Visakapattanam

12. **Mr Tom Mathews** **Industry**
Divisional Manager
LIC of India
Goa

13. **Dr. Ancykutty Joseph** **Alumnus**
Former Principal
St Dominic's College
Kanjirapally

FACULTY MEMBERS WHO HAVE CONTRIBUTED TOWARDS CURRICULUM AND SYLLABI OTHER THAN BOS MEMBERS

1. **Ms. Rinsy Thomas**
   Associate Professor
   Assumption College Autonomous
   Changanacherry

2. **Ms. Ann Mary Philip**
   Assistant Professor
   Assumption College Autonomous
   Changanacherry

3. **Ms Jayasree Thomas**
   Assistant Professor
   Assumption College Autonomous
   Changanacherry

4. **Ms Alphy Joseph**
   Assistant Professor (on contract)
   Assumption College Autonomous
   Changanacherry

5. **Ms Treesa Maria Kuriakose**
   Assistant Professor (on contract)
   Assumption College Autonomous
   Changanacherry

MINUTES OF BOARD OF STUDIES IN MATHEMATICS

Minutes of the meeting of the Board of Studies in Mathematics (UG) held on 22nd December 2016, 10.00 am at Mini Conference Hall, Assumption College, Autonomous, Changanacherry. The following members were present:

1.	Dr. M P Rajan (Chairman)	Sd/-
2.	Ms Rosamma VA (Convener)	Sd/-
3.	Dr Sunil C Mathew	Sd/-
4.	Dr K M Kurian.	Sd/-
5.	Dr. Ancykutty Joseph	Sd/-
6.	Dr. Antony Mathews	Sd/-
7.	Ms Rinsy Thomas	Sd/-
8.	Dr. Jikcey Isaac.	Sd/-
9.	Ms Jayasree Thomas	Sd/-

Agenda

1. Approval of the minutes of the previous Board of Studies meeting held on 30th May 2016**.**
2. Discussion on the draft syllabus of UG Programme in Mathematics from 2017 -18 admission onwards and its finalization.
3. Preparation of the Board of Examiners (Theory) for second semester UG Examination, 2016 – 17.
4. Other items permitted by the chair.

Recommendations / Suggestions

1. The Board of Studies approved the minutes of the previous meeting held on 30th May 2016**.**
2. Board of Studies finalized syllabus of BSc Mathematics Programme – Core course Mathematics, Complementary Course for BSc Physics, BSc. Chemistry, BSc Computer Science and BCA programmes.
3. Board of Studies finalized syllabus of Statistics complementary course for BSc Mathematics, BSc Computer Science and BCA Programmes.
4. Board of Studies suggested to include textbooks of international standards in our curriculum.

5. Dr M P Rajan, Chairman of Board of Studies suggested to include a new course Scientific Computing in the 6th Semester as core course and also include Cryptography in the 5th Semester as a module in Discrete Mathematics core course. The above said course needs lab hour 12 hours per week.
6. Board of Studies suggested to apply PG Programme in Mathematical Science in the next academic year.
7. Board of Studies entrusted HOD to form panel of question paper setters and Board of Examiners (theory) for second semester UG Examination 2016 -17.

The meeting ended at 12.30pm

Read and confirmed

Dr. M P Rajan	Chairman	Sd/-
Dr Sr Marykutty Joseph	Principal Assumption College	Sd/-

ACKNOWLEDGEMENT

We thank God, the Almighty, for His showers of blessings in the successful completion of the syllabus in Mathematics and Statistics.

The board of studies in Mathematics express our deepest gratitude to the patron His Grace Mar Joseph Perumthottam, Arch Bishop of Changanacherry for the moral support and encouragement.

We place our special gratitude to Rev. Dr. James Palackal, our manager for stimulating suggestions and encouragement and also for sharing his vision of Higher Education.

We put on record our sincere thanks to the Honorable Vice Chancellor, Pro Vice Chancellor, Registrar and the members of the syndicate and all the academic bodies of Mahatma Gandhi University, for the guidance and help extended towards the college.

We acknowledge with much appreciation Dr. Sr. Marykutty Joseph, Principal, Assumption College for her imparted enthusiasm and willingness to support in all the junctures of our venture.

We express our special gratitude to Rev. Sr. Thresiamma Devasia and Dr. Regimol C Cherian the Vice Principals of the college, for their stimulating suggestions and encouragement.

I wish to express my sincere thanks to all the board of studies members for their help and expert guidance rendered by them to restructure the syllabus. I am indebted to all the subject experts for their helpful comments & suggestions.

Our heartfelt gratitude towards the Governing Council and Academic Council for their support and motivation in this regard.

The Board of studies acknowledges the contribution of the faculty members of the department for their contribution towards the curriculum and syllabus restructuring.

Dr M P Rajan
Chairman, Board of Studies
Assumption College
Autonomous

CONTENTS

PREFACE

Reasoning and sense making should occur in every Mathematics classroom. Addressing reasoning and sense making does not need to be an extra burden for students who are having a difficult time just learning the procedures. The structure that reasoning brings forms a vital support for understanding and continued learning. Currently, many students have difficulty because they find Mathematics meaningless. With purposeful attention and planning, teachers can hold all students in every classroom accountable for personally engaging in reasoning and sense making, and thus lead students to experience reasoning for themselves rather than merely observe it.

This course provides an introduction to research on learning and teaching Mathematics. The course is intended for undergraduates who are considering becoming Mathematics teachers or Mathematics tutors or are interested in careers in Mathematics education, technology development, research, etc. The course is designed for students who enjoy Mathematics, including those with a major or minor Mathematics background.

Developed as a means to make Mathematics accessible to all students, this syllabus has renewed a focus on pedagogy and, perhaps most important, the relationship among mathematics, the learner and the real world. The Mathematics syllabus focuses specifically on the relationship between given skills or aspects of knowledge and the contexts in which people use them. An application relates the theoretical to the practical and connects the abstract to the concrete. They tie what students already know and their sense of the real world to what they are about to learn.

ABOUT B Sc MATHEMATICS PROGRAMME

The courses for the BSc Mathematics 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 university 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.

As learning Mathematics is doing Mathematics, to this end, some activities are prescribed to increase students' participation in learning.

Students can make use of books and materials available in the web to prepare for the presentation. It is imperative that these are taken as part of the syllabus. These should be included in the internal examination. However they are not to be included for the university examinations.

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.

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 other departments/ or by the same department, 8 complementary courses, or otherwise specified, 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.

Course Coding :

Every course in the programme is coded according to the following criteria.

1. The first two letters forms the programme ie., MM (Mathematics Main)
2. One digit to indicate the semester. ie., MM1 (Mathematics Main, Ist Semester)
3. Next two letters forms the type of courses such as CC for common course, CR for core courses, CM for complementary courses, CB for choice based course, OP for open course, PR for project and VV for viva voce.
4. Two digits to indicate the course number of that semester. ie., MM1CRT01 (Mathematics Main, Ist Semester, Core course theory, Course number 01)

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 Statistics, Physics 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 Integral Transforms. 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 including Real Analysis, Differential equations, Complex Analysis, Linear Algebra, Metric Spaces, Graph Theory, Cryptography, Numerical Methods, Operations Research and had experience of independent works such as project, seminar etc.

REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, (2017 ADMISSION ONWARDS)

1. TITLE

These regulations shall be called "**Regulations for Under Graduate Programmes under Choice Based Credit System, 2016**", Assumption College, Autonomous.

2. SCOPE

Applicable to all regular and self-financing Under Graduate Programmes conducted by the College with effect from 2017 admissions.

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. A sequence of 18 such academic weeks constitutes a semester.

3.2. ***'College Co-ordinator'*** is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. She shall be nominated by the College Principal.

3.3. ***'Common Course I'*** means a course that comes under the category of courses for English and ***'Common Course II'*** means additional language, a selection of both is compulsory for Model I and Model II undergraduate programmes.

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

3.5. ***'Core course'*** means a course in the subject of specialization within a degree programme.

3.6. ***'Course'*** means Paper(s) which will be taught and evaluated within a semester.

3.7. *'**Credit'*** is the numerical value assigned to a paper according to the relative importance of the content of the syllabus of the programme**.**

3.8. ***'Department'*** means any teaching department in a college.

3.9. ***'Department Co-ordinator'*** is a teacher nominated by the Head of Department to co-ordinate the continuous evaluation undertaken in that department.

3.10. '***Extra Credits'*** are additional credits awarded to a student over and above the minimum credits required for a programme for achievements in co-curricular activities carried out outside the regular class hours as directed by the college.

3.11. ***Grace Marks*** shall be awarded to candidates as per the Orders issued from time to time**.**

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

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

3.14. ***'Institutional Average (IA)'*** means average mark secured (Internal+External) for a paper at the College level.

3.15. ***'Open course'*** means a course outside the field of specialization of a student and offered by the Departments which can be opted by a student.

3.16. '***Parent Department'*** means the department which offers core courses in an under graduate programme.

3.17. ***'Programme'*** means a three year programme of study and examinations spread over six semesters, according to the regulations of the respective programme, the successful completion of which would lead to the award of a degree.

3.18. ***'Semester'*** means a term consisting of a minimum of **450** contact hours distributed over **90** working days, inclusive of examination days, within **18** five-day academic weeks.

3.19. Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes of the University.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility of admission, Norms for admission, reservation of seats for various Under Graduate Programmes shall be according to the rules framed by the University in this regard from time to time.

4.2 Students can opt for any one (other than core and complementary subjects) of the Open course offered by different departments of the college in the fifth semester (subject to the availability of vacancy in the concerned discipline). Selection of students in the open course will be done in the college based on the interest of the students.

5. DURATION

5.1 The duration of U.G. programmes shall be ***6 semesters.***

5.2 There shall be two semesters in an academic year. The duration of odd semesters shall be from **June to October** and that of even semesters from **November to March.** There shall be three days semester break after odd semesters and two months 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 the University except in case of open courses for which there shall be a minimum of 15 and maximum of sanctioned strength including marginal increase.

6.2 The number of courses/credits that a student can take in a semester is governed by the provisions in these regulations pertaining to the minimum and maximum number of credits permitted.

6.3 Those students who possess the required minimum attendance and progress during an academic year/semester and could not register for the annual/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 SYLLABUS

7.1. The U.G. programmes shall include (a) Common courses I & II, (b) Core courses, (c) Complementary Courses, (d) Open Course.

7.2. There shall be one Open course in the fifth semester.

7.3. There shall be one Choice based paper in the sixth semester with a choice of one out of three elective papers.

7.4. A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% are required for a pass for a paper. For a pass in a programme, a separate minimum of Grade D is required for all the individual papers. If a candidate secures F Grade for any one of the paper offered in a semester/programme, only F grade will be awarded for that semester/programme until she improves this to D Grade or above within the permitted period.

7.5. Improvement/supplementary examinations will be conducted only in the even semesters following the publication of the results. As an exemption to this, prior to final semester, the improvement/supplementary examinations can be arranged along with the previous end semester exam.

7.6. Students discontinued from previous regulations, can pursue their studies in **Regulations for Under Graduate Programmes under Choice Based Course Credit System, 2016**” after obtaining readmission. These students have to complete the programme as per **Regulations for Under Graduate Programmes under Choice Based Credit System, 2016**”.

8. PROGRAMME STRUCTURE

Model I BA/BSc

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 + complementary including Project	79
f	Credits required from Open course	3
g	Minimum attendance required	75%

Model II BA/BSc

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from common course I	16
d	Credits required from common course II	8
e	Credits required from Core + complementary + vocational courses including Project	93
f	Credits required from Open course	3
g	Minimum attendance required	75%

Model III BA/BSc/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
f	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)

9.2 The internal to external assessment ratio shall be 1:4, for both courses with or without practical. There shall be a maximum of 80 marks for external evaluation and maximum of **20** marks for internal evaluation. 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**
95 and above	O - 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
50 to below 55	C - Average	5
40 to below 50	D - Pass	4
Below 40	F - Fail	0
	Ab - Absent	0

Note: Decimal are to be rounded to the next whole number

10. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a course is calculated using the formula

CP = C* x *GP, where C = Credit; GP = Grade point

Credit Point Average (CPA) of a Semester/Programme is calculated using the formula

CPA = TCP/TC, where TCP = Total Credit Point; TC = Total Credit

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

CPA	Grade
Equal to 9.5 and above	*O - Outstanding*
Equal to 8.5 and below 9.5	*A+- Excellent*
Equal to 7.5 and below 8.5	*A - Very Good*
Equal to 6.5 and below 7.5	*B+- Good*
Equal to 5.5 and below 6.5	*B - Above average*
Equal to 5 and below 5.5	*C - Average*
Equal to 4 and below 5	*D - Pass*
Below 4	*F - Fail*

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% 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. Candidate who secures **D** grade and above will be eligible for higher studies.

11. MARKS DISTRIBUTION FOR EXTERNAL EXAMINATION AND INTERNAL EVALUATION

The external examination of all semesters shall be conducted by the College at the end of each semester. Internal evaluation is to be done by continuous assessment. **All the components of the internal assessment are mandatory.** Mark 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

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

11.2 For all courses with practical

a) Marks of theory - External Examination : 60

b) Marks of theory - Internal Evaluation : 10

Components of Theory – Internal Evaluation	**Marks**
Attendance	**3**
Assignment/Seminar/Viva	**2**
Test Papers (2 x 2.5=5)	**5**
Total	**10**

c) Marks of Practical - External Examination : 40
(only in even semesters)

d) Marks of Practical – Internal Examination : 20
(odd and even semesters combined annually)

Components of Practical – Internal Evaluation	**Marks**
Attendance	**4**
Test Paper	**5**
Record*****	**7**
Lab Involvement	**4**
Total	**20**

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

11.3 Project Evaluation: (Max. marks 100)

(a) Marks of external examination : 80

(b) Marks of internal examination : 20

Components of External evaluation of Project	**Marks**
Dissertation (External)	50
Viva-Voce (External)	30
Total	**80**

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

12. Attendance Evaluation

1) For all courses without practical

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

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

2) For all courses with practical

% of attendance	Marks for theory		% of attendance	Marks for practical
90 and above	3		90 and above	4
80 – 89	2		85 – 89	3
75 - 79	1		80-84	2
			75-79	1

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

13. ASSIGNMENTS/SEMINAR/VIVA

Assignments/Seminar/Viva is to be done from 1st to 5th Semesters. Each teacher can decide the mode of evaluation. The student shall appear for compulsory viva-voce in the 6th semester for each paper.

14. INTERNAL ASSESSMENT TEST PAPERS

Two internal 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 Department for three years and shall be made available for verification. The responsibility of evaluating the internal test papers is vested on the teacher(s), who teach the paper.

14.1 Grievance Redressal Mechanism

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

Level 1: Dept. Level: The department cell chaired by the Head, Dept. Coordinator and teacher in-charge, as members.

Level 2: **College level**: A committee with the Principal as Chairman, Controller of Examination and College Coordinator as members.

14.2 The college council shall nominate a senior teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester.

14.3 The internal evaluation report in the prescribed format should reach the Controller of Examination office before the 4th week of October and March in every academic year.

15. EXTERNAL EXAMINATION

The external examination of all semesters 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. Condonation of shortage of attendance to a maximum of 10 days or 50 hours in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the Principal/Controller of Examination on valid grounds. This condonation shall not be counted for internal assessment.

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 even with condonation of shortage of attendance shall repeat the course along with the next batch.

15.2 All students are to do a **project in the area of core course**. This project can be done individually or as a group of 3 students. 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 College. External project evaluation and Viva is compulsory for all subjects and will be conducted at the end of the programme.

15.3 A student who registers her name for the external exam for a semester 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 examination for the same semester, subsequently.

16. All programmes and courses shall have unique alphanumeric code.

17. 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. The question setter shall also submit a detailed scheme of evaluation along with the question paper.

Question paper shall be a judicious mix of objective type, short answer type, short essay type /problem solving type and long essay type questions according to the question paper blue print given.

Pattern of questions for external examination for theory paper without practical

Pattern	Total no. of questions	No. of questions to be answered	Marks of each question	Total marks
Very short answer	10	10	1	10
Short Answer	12	8	2	16
Short essay/problem	9	6	4	24
Essay	4	2	15	30
	35	26	X	80

Pattern of questions for external examination for theory paper with practical.

Pattern	Total no. of questions	No. of questions to be answered	Marks of each question	Total marks
Very short answer	8	8	1	8
Short Answer	10	6	2	12
Short essay/problem	6	4	4	16
Essay	4	2	12	24
	28	20	X	60

Each BOS shall specify the length of the answers in terms of number of words. Pattern of questions for external examination of practical papers will be decided by the concerned Board of Studies/ Expert Committees.

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 College

(b) Name of the University

(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 Max. Marks (Int., Ext. & 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 (IA) of the marks of all papers.

(i) The total credits, total marks (Max. & Awarded) and total credit points in the semester.

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

(k) Cumulative Credit Point Average (CCPA) corresponding to Common courses, Core and Complementary (separately and together) and whole programme, as the case may be.

(l) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all papers taken during the final semester examination and shall include the final grade/marks scored by the candidate from **1st to 5th** semester and the overall grade/marks 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, Dept. Co-ordinator and A.O/Superintendent as members.

PROGRAMME STRUCTURE

Total Credits: 120

Semester I **Total Credits: 20**

No.	Course Title	Hrs/Week	Credits
1.	**Common course I** English I English II	 **5** **4**	 **4** **3**
2.	**Common Course II** Language	 **4**	 **4**
3.	**Core Course I**	**4**	**3**
4.	**Complementary course I** Statistics	**4**	**3**
5.	**Complementary course II** Physics Theory Physics Practical	 **2** **2**	 **2** **-**
		25hrs	**19**

Semester II **Total Credits: 20**

No.	Course Title	Hrs/Week	Credits
1.	**Common course I** English I English II	 **5** **4**	 **4** **3**
2.	**Common Course II** Language	 **4**	 **4**
3.	**Core Course II**	**4**	**3**
4.	**Complementary course I** Statistics	**4**	**3**
5.	**Complementary course II** Physics Theory Physics Practical	 **2** **2**	 **2** **2**
		25hrs	**21**

Semester III **Total Credits: 20**

No.	Course Title	Hrs/Week	Credits
1.	**Common course I** English I	 **5**	 **4**
2.	**Common Course II** Language	 **5**	 **4**
3.	**Core Course III**	**5**	**4**
4.	**Complementary course I-** Statistics	**5**	**4**
5.	**Complementary course II** Physics Theory Physics Practical	 **3** **2**	 **3** **-**
		25hrs	**19**

Semester IV **Total Credits: 20**

No.	Course Title	Hrs/Week	Credits
1.	**Common course I** English I	**5**	**4**
2.	**Common Course II** Language	**5**	**4**
3.	**Core Course IV**	**5**	**4**
4.	**Complementary course I** Statistics	**5**	**4**
5.	**Complementary course II** Physics Theory Physics Practical	 **3** **2**	 **3** **2**
		25hrs	**21**

Semester V **Total Credits: 19**

No.	Course Title	Hrs/Week	Credits
1.	**Core Course V**	**5**	**4**
2.	**Core Course VI**	**6**	**4**
3.	**Core Course VII**	**5**	**4**
4.	**Core Course VIII**	**5**	**4**
5.	**Open Course**	**4**	**3**
		25hrs	**19**

Semester VI **Total Credits: 21**

No.	Course Title	Hrs/Week	Credits
1.	**Core Course IX**	**6**	**4**
2.	**Core Course X**	**5**	**4**
3.	**Core Course XI**	**5**	**4**
4.	**Core Course XII**	**6**	**4**
5.	**Choice based course**	**3**	**3**
6.	**Project**	**0**	**2**
		25hrs	**21**

1. MATHEMATICS CORE COURSES

Semester	Title of the Course	Number of hours per week	Total Credits	Total hours per semester	University Exam Duration	Marks	
						Internal	External
I	MM1CRT01: Logic and Differential Calculus	4	3	72	3 hrs	20	80
II	MM2CRT02 : Analytic Geometry, Trigonometry and Matrices	4	3	72	3 hrs	20	80
III	MM3CRT03 : Integral Calculus, Partial Differentiation and Number Theory	5	4	90	3 hrs	20	80
IV	MM4CRT04 : Vector Calculus, Theory of Equations and Laplace Transforms	5	4	90	3 hrs	20	80
V	MM5CRT05: Real Analysis - I	5	4	90	3 hrs	20	80
	MM5CRT06: Differential Equations	6	4	108	3 hrs	20	80
	MM5CRT07 : Abstract Algebra	5	4	90	3 hrs	20	80
	MM5CRT08 : Human Rights and Mathematics for Environmental Studies	5	4	90	3 hrs	20	80
	MM5OPT01: Open course: Foundations of Mathematics	4	3	72	3 hrs	20	80
VI	MM6CRT09: Real Analysis -II	6	4	108	3 hrs	20	80
	MM6CRT10 : Complex Analysis	5	4	90	3 hrs	20	80
	MM6CRT11: Linear Algebra and Metric spaces	5	4	90	3 hrs	20	80
	MM6CRT12 : Discrete Mathematics and Numerical Methods	6	4	108	3 hrs	20	80
	Choice Based Course MM6CBT01: Operations Research MM6CBT02: Fuzzy Mathematics MM6CBT03: Topology	3	3	54	3 hrs	20	80
	MM6CPR01: Project	-	2	-	-	20	80

2. COMPLEMENTARY MATHEMATICS FOR B.SC. PHYSICS/ CHEMISTRY

Semester	Title of the Course	Number of hours	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
I	MM1CMT01 : Mathematics-I-Partial Differentiation, Matrices, Trigonometry and Numerical Methods	4	3	72	3 hrs	20	80
II	MM2CMT02 : Mathematics-II-Integral Calculus, Ordinary and Partial Differential Equations	4	3	72	3 hrs	20	80
III	MM3CMT03 : Mathematics-III-Vector Calculus, Analytic Geometry and Abstract Algebra	5	4	90	3 hrs	20	80
IV	MM4CMT04 : Mathematics-IV-Fourier Series, Laplace Transforms and Linear Algebra	5	4	90	3 hrs	20	80

3. COMPLEMENTARY MATHEMATICS FOR B. SC COMPUTER SCIENCE

Semester	Title of the paper	Number of hours	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
I	MM1CSMT1: Discrete Mathematics – I- Relations, Logic and Propositional Calculus, Lattices and Boolean Algebra(common with BCA)	4	4	72	3 hrs	20	80
II	MM2CSMT2: Discrete Mathematics – II- Matrices, Number Theory and Graph Theory(common with BCA)	4	4	72	3 hrs	20	80
III	MM3CSMT3- Basic Statistics and Probability Theory	4	4	72	3 hrs	20	80

4. COMPLEMENTARY MATHEMATICS FOR B.C.A

Semester	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Marks	
						Internal	External
I	MM1CAMT1: Discrete Mathematics – I- Relations, Logic and Propositional Calculus, Lattices and Boolean Algebra(common with B Sc Computer Science)	4	4	72	3 hrs	20	80
II	MM2CAMT2: Discrete Mathematics - II- Matrices, Number Theory and Graph Theory(common with B Sc Computer Science)	4	4	72	3 hrs	20	80
IV	MM4CAMT3: Operations Research	4	4	72	3 hrs	20	80

The Structure of the Six Complementary Courses in Statistics offered for Various UG Programmes

Semester	Title of the Course	Number of hours per week	Total Credits	Total hours per semester	University Exam Duration	Marks	
						Internal	External
BSc. Mathematics Programme							
I	ST1MMMT1- Basic Statistics (common with BCA)	4	3	72	3 hrs	20	80
II	ST2MMMT2 – Probability Distribution of Random Variables	4	3	72	3 hrs	20	80
III	ST3MMMT3 – Standard Probability Distributions	5	4	90	3 hrs	20	80
IV	ST4MMMT4 – Statistical Inference	5	4	90	3 hrs	20	80
BCA Programme							
I	ST1CAMT1-Basic Statistics (common with B Sc Mathematics)	4	4	72	3 hrs	20	80
III	ST3CAMT2- Advanced Statistical Methods	4	4	72	3 hrs	20	80

SYLLABI OF CORE COURSES

SEMESTER I

LOGIC AND DIFFERENTIAL CALCULUS

Core - I

Course Code: MM1CRT01
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 3

MODULE I: LOGIC (20hrs)

Propositional Logic, Truth Tables, The operators NOT, AND, OR, and XOR, Negations of AND, OR, and, NOT, Implication and the biconditional, Operator precedence, Logical Equivalence, Important logical equivalences and rules of inference, Proving that a statement is a tautology, Sets and propositions as Boolean Algebras, Proving Additional Boolean Algebra Properties, Predicate Logic, Quantifiers, Proof Strategies, Trivial proof, Direct proof, Indirect proof: Proving the contrapositive, Proof by contradiction , Proof by cases.

Text 1: Chapter 2: Sections: 2.3.1 to 2.3.7, 2.4.1, 2.4.2, 2.5.1, 2.5.2, 2.6.1
Chapter 3: Sections: 3.3.1 to 3.3.5.

MODULE II: DIFFERENTIAL CALCULUS – I (15hrs)

Derivative of a function, Differentiation rules, Derivatives of Trigonometric functions, The chain rule, Implicit differentiation and rational exponents, Extreme values of functions, the mean value theorem, The first derivative test for local extreme values.

Text 2: Chapter 2: (Sections 2.3 and 2.7 excluded)
Chapter 3: Sections: 1 to 3

MODULE III: DIFFERENTIAL CALCULUS - II (12 hrs)

Successive Differentiation and Indeterminate forms

Text 3 : Chapter 5 and Chapter 10

MODULE IV: DIFFERENTIAL CALCULUS – III (25 hrs)

Expansion of functions using Maclaurin's theorem and Taylor's theorem, 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 3: Chapter 6, Chapter 14, Chapter 15: Sections: 15.1 to 15.3
Chapter 18: Sections: 18.3 to 18.8 (Proofs of all theorems are excluded)

Text Books:

1. **Gossett, Eric. (2003). Discrete Mathematics with proofs. Pearson.**

2. **Thomas, George. B. & Finney, Ross. L. Calculus and Analytic Geometry. (9th edition). Addison - Wessly.**
3. **Narayan, Shanti. & Mittal, P. K. Differential Calculus. S Chand and Company.**

Reference:

1. **Ross, Kenneth. A. & Wright, Charles. R. B. Discrete Mathematics. Pearson Education. Dorling Kindersley India Pvt. Ltd.**
2. **Grimaldi, Ralph. P. & Ramana, B. V. Discrete and Combinatorial Mathematics. Pearson Education. Dorling Kindersley India Pvt. Ltd.**
3. **Maity, K. C.& Ghosh, R. K. Differential Calculus. New Central Books Agency.**
4. **Saxena, Pratiksha.(2014). Differential Calculus. McGraw Hill Education India Pvt Ltd.**

SEMESTER II

ANALYTIC GEOMETRY, TRIGONOMETRY AND MATRICES

Course Code: MM2CRT02
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 3

Core - 2

MODULE I: GEOMETRY OF TWO DIMENSIONS: CONIC SECTIONS (17 Hrs)

Conic sections and quadratic equations, Circles, Parabolas, Ellipses, Hyperbolas, Classifying Conic sections by Eccentricity, Quadratic Equations and rotations, Discriminant test, Parametrizations of Plane Curves, Calculus with Parametrized Curves, Slopes of Parametrized Curves, Lengths of Parametrized Curves, Centroids, The Area of a surface of Revolution.

Text 1: Sections: 9.1 to 9.5

MODULE II: GEOMETRY OF TWO DIMENSIONS: POLAR EQUATIONS (17 Hrs)

Polar Coordinates, Definition, Cartesian versus Polar coordinates, Graphing in Polar Coordinates, Symmetry, Slopes, Polar Equation for Conic Sections, Lines, Circles, Ellipses, Parabolas and Hyperbolas Unified.

Text 1: Sections: 9.6 to 9.8

MODULE III: TRIGONOMETRY (18 hrs)

Exponential series for complex quantities, Circular functions for complex angles, Periods of complex circular functions, Hyperbolic Functions, Inverse circular functions, Inverse hyperbolic functions, Summation of Series, Factorisation of $x^{2n}-2x^n a^n \cos n\theta + a^{2n}$, x^n-1 , x^n+1.

Text 2: Chapters V: Sections: 56 to 79
Chapter VIII: Sections: 103 to 109
Chapter IX: Sections: 114, 115, 119, 120

MODULE IV: MATRICES (20 hrs)

Some Types of Matrices: Identity Matrix, Special square matrices, The inverse of a matrix, The transpose of a matrix, Symmetric matrices, The Conjugate of a matrix, Hermitian Matrices, Direct Sum.

Equivalence : The rank of matrix, Elementary Transformations, The inverse of an Elementary transformation, Equivalent matrices, Row Equivalence, Normal Form of a Matrix, Elementary Matrices.

Linear Equations: Definitions, Solution using a matrix,, Non Homogeneous Equations, Homogeneous Equations.

The Characteristic Equation of a matrix: The Characteristic Equation, General Theorems

Lamda Matrices: Cayley Hamilton Theorem.

Text 3: Relevant Sections of Chapter 2, 5, 10, 19 and 23

Text books:

1. **Thomas, George. B. & Finney, Ross. L. (2016). Calculus and Analytic Geometry. (12th edition). Pearson.**
2. **Looney, S. L. Plane Trigonometry Part II. S Chand and Company Ltd.**
3. **Ayres, Frank. Jr. Matrices. Schaum's Outline Series. TMH Edition.**

Reference:

1. **Anton, Howard., Bivens, Irl. & Davis, Stephen. (2015). Calculus. (10th edition). International student Version. Wiley.**
2. **Thomas, George. B. Jr. (2008). Thomas' Calculus. (12th edition). Pearson.**
3. **Narayan, Shanti. & Mittal, P. K. Matrices. S Chand and Company.**

SEMESTER III

INTEGRAL CALCULUS, PARTIAL DIFFERENTIATION AND NUMBER THEORY

Core - 3

Course Code: MM3CRT03
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: INTEGRAL CALCULUS (20 Hrs)

Volumes using Cross-sections, Solids of revolution: The Disk Method, Solids of revolution: The Washer Method, Volumes using cylindrical shells, Shell Method, Arc length, Areas of surfaces of Revolution, Revolution about the x-axis and y-axis.

Text 1: Chapter 6: Sections: 6.1 to 6.4

MODULE II: MULTIPLE INTEGRALS (25 Hrs)

Double and iterated integrals over rectangles, Fubini's theorem for calculating Double integrals, Double integrals over general regions, Properties of double integrals, Area by double integration, Areas of bounded regions in the plane, Average value, Double integrals in polar form, Triple integrals in rectangular co-ordinates, Average value of function in space, Triple integrals in cylindrical and spherical co-ordinates, Substitutions in multiple integrals.

Text 1: Chapter 15 (Sections 15.6 is excluded)

MODULE III: PARTIAL DIFFERENTIATION (20 Hrs)

Partial derivatives, Functions of more than two variables, Partial derivatives and continuity, Mixed derivative theorem, Differentiability, The Chain Rule, Implicit differentiation revisited, Functions of many variables, Extreme values and saddle points, Derivative tests for local extreme values, Absolute maxima and minima on closed bounded regions, Lagrange Multipliers, Constrained maxima and minima.

Text 1: Chapter 14: Sections: 14.3, 14.4, 14.7 and 14.8

MODULE IV: NUMBER THEORY (25 Hrs)

The Fundamental Theorem of Arithmetic and Basic Properties of Congruence, Fermat's Little Theorem and Pseudoprimes, Wilson's Theorem, The sum and number of divisors, Euler's Phi-Function, Euler's Theorem

Text 2: Sections: 3.1, 4.2, 5.2 (pseudo primes is excluded), 5.3, 6.1 (up to theorem 6.3), 7.2, 7.3 (Second proof of Euler's theorem onwards excluded)

Text Books:

1. **Thomas, George. B. Jr. (2016). Thomas' Calculus. (12th edition). Pearson.**
2. **Burton, David. M. (2009). Elementary Number Theory. (7th edition). India: McGraw Hill Education Private Ltd.**

Reference:

1. **Taylor, Angus. E. (1995). Advanced Calculus. Ginn and company.**
2. **Narayan, Shanti. & Mittal, P. K. Integral Calculus. S Chand and Company.**
3. **Anton, Howard., Bivens, Irl. & Davis, Stephen. (2015). Calculus. (10th edition). International student Version. Wiley.**
4. **Bernard, S. & Child, J. M. (2010). Higher Algebra. India: AITBS Publishers.**

SEMESTER IV
VECTOR CALCULUS, THEORY OF EQUATIONS AND LAPLACE TRANSFORMS

Core - 4

Course Code: MM4CRT04
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: VECTOR CALCULUS (20 hrs)

Lines and planes in space, Curves in space and their tangents, Arc length in space, Curvature and normal vectors of a curve, Tangential and normal components of acceleration, Directional derivatives and gradient vectors

Text 1: Sections: 12.5 , 13.1 , 13.3 , 13.4 , 13.5 , 14.5

MODULE II: INTEGRATION IN VECTOR FIELDS (25 hrs)

Line integrals (exclude mass and moment calculations), Vector fields and line integrals: work circulation and flux, Path independence, conservative fields and potential functions, Green's theorem in the plane(no proof), Surface integrals (exclude moments and masses of thin shells), Stokes' theorem (no proof), Divergence theorem and unified theory (no proof).

Text 1: Sections: 16.1, 16.2, 16.3, 16.4, 16.6, 16.7 and 16.8

Module III: THEORY OF EQUATIONS (25 hrs)

Introduction: Definitions, Division algorithm: Synthetic division, Fundamental theorem of classical algebra, Remainder theorem, Factor theorem, Nature of the roots of an equation: Surd or complex roots occurs in pairs, HCF and LCM of polynomials, Relation between roots and coefficients, Transformation of equations, Cardan’s method of solution of a cubic equation, Descartes’ rule of signs: Rolle’s Theorem.

Text 2: Chapter 3: Sections: 3.1 to 3.11

MODULE IV: LAPLACE TRANSFORMS (20 hrs)

Laplace transform, Inverse transform, Linearity, Shifting, Transforms of derivatives and Integrals, Differential equations, Initial value problems, Differentiation and Integration of Transforms, Differential Equation with variable coefficients, Convolution, Differential Equations, Integral equations, Laplace Transform: General formula (relevant formulae only), Table of Laplace Transforms (relevant part only)

Text 1: Sections: 5.1, 5.2, 5.4, 5.5, 5.8 and 5.9

Text Books:

1. **Thomas, George. B. Jr. (2016). Thomas’ Calculus. (12th edition). Pearson.**
2. **Ghosh, Ram. Krishna. & Maity, Kantish. Chandra. (2013). Higher Algebra. New Central Book Agency (P) Ltd.**

3. **Kreyszig, Erwin. (2001). Advanced Engineering Mathematics. (8th edition). India: Wiley.**

Reference:

1. **Anton, Howard., Bivens, Irl. & Davis, Stephen. (2015). Calculus. (10th edition). International student Version. Wiley.**
2. **Taylor, Angus. E. (1995). Advanced Calculus. Ginn and company.**
3. **Bernard, S. & Child, J. M. (2010). Higher Algebra. India: AITBS Publishers.**
4. **Grewal, B.S. (2015). Higher Engineering Mathematics. (43rd edition). Khanna Publishers.**
5. **Bali, N. P. & Goyal, Manish. (2014). A Text Book of Engineering Mathematics. Laxmi Publications Limited.**

SEMESTER V

REAL ANALYSIS - I

Core - 5

Course Code: MM5CRT05
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: REAL NUMBERS (20Hrs)

Sets and functions, Mathematical induction, Finite and infinite Sets, The algebraic and order properties of $\mathbb{R}$, Absolute value and real line , The completeness property of $\mathbb{R}$, Applications of the supremum property, Intervals.

Chapters: 1, 2

MODULE II: SEQUENCES (25Hrs)

Sequences and their limits, Limit theorems, Monotone sequences, Subsequences and the Bolzano-Weierstrass theorem, The Cauchy criterion, Properly divergent sequences.

Chapter 3: Sections: 3.1 to 3.6

MODULE III: SERIES (25 Hrs)

Introduction to series, Absolute convergence, Tests for absolute convergence, Tests for non absolute convergence.

Chapter 3: Section: 3.7

Chapter 9: Sections: 9.1 to 9.3

MODULE IV: LIMITS (20 Hrs)

Limits of functions, Limit theorems, Some extensions of the limit concept.

Chapter 4

Text Book:

Bartle, Robert. G. & Sherbert, Donald. R. (2007). Introduction to Real Analysis. (3rd edition). Wiley.

References:

1. **Malik, S. C. & Arora, Savita. Mathematical Analysis. (4th edition). New Age International Publishers.**
2. **Narayan, Shanti. & Raisinghania, M. D. Elements of Real Analysis. S Chand and Company Ltd.**
3. **Rudin, Walter. Real and Complex analysis. (3rd edition). McGraw Hill International.**
4. **Taylor, Angus. E. (1995). Advanced Calculus. Ginn and company.**

SEMESTER V
DIFFERENTIAL EQUATIONS

Course Code: MM5CRT06
Teaching hours: 6 Hrs/ week (Hrs / Sem: 108)
Credits: 4

Core - 6

MODULE I: DIFFERENTIAL EQUATION (26 hrs)
The nature of solutions, Separable equations, First order linear equations, Exact equations, Orthogonal trajectories and families of curves, Homogeneous equations, Integrating factors, Reduction of order-dependent variable missing-independent variable missing
Text 1: Chapter 1: Sections: 1.2 to 1.9

MODULE II: SECOND ORDER LINEAR EQUATIONS (26 hrs)
Second order linear equations with constant coefficients, Euler's equidimensional equations, The method of undetermined coefficients, The method of variation of parameters, The use of a known solution to find another, Higher order linear equations
Text 1: Chapter 2: Sections: 2.1 to 2.4, 2.7(example 2.17 is excluded)

MODULE III: POWER SERIES SOLUTIONS AND SPECIAL FUNCTIONS (26 hrs)
Series solutions of first order differential equations, Second order linear equations: ordinary points Legendre's equations, Regular singular points, Bessel's Equation of order p, Frobenius Series, More on regular singular points.
Text 1: Chapter 4: Sections: 4.2 to 4.5

MODULE IV: PARTIAL DIFFERENTIAL EQUATIONS (30 hrs)
Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Pfaffian differential forms and equations, Solution of Pfaffian differential equations in three variables (By inspection, Variables separable, One variable separable and homogeneous equations only), Partial differential Equations, Origin of first order partial differential equations, Linear equations of the first order.
Text 2: Chapter 1: Sections: 3, 5, 6 (a,b,c and d only)
Chapter 2 : Sections: 1, 2 and 4.
(Proofs of all theorems in module IV are excluded)

Text Book:

1. **Simmons, G.F., Krantz, S.G. Differential Equations. Tata McGraw Hill Education Private Limited.**
2. **Sneddon, Ian. Elements of Partial Differential Equation. New York, Dover Publications.**

Reference:

1. **Ross, Shepley. L. Differential Equations. (3rd edition). India, Wiley.**
2. **Siddiqi, A. H. & Manchanda, P. (2009). A First Course in Differential Equations with Applications, Macmillian Publishers India Limited.**
3. **Boyce, William. E. & Diprima, Richard. C. (2014). Elementary Differential equations and Boundary Value Problems. (9th edition). Wiley.**
4. **Ahsan, Zafar. Differential Equations and their Applications. (2nd edition). PHI.**

SEMESTER V

ABSTRACTALGEBRA

Course Code: MM5CRT07

Core - 7

Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: GROUPS AND SUBGROUPS (25 hrs)

Binary operations, definitions and examples, Isomorphic binary structures, Groups, Elementary properties of groups, Finite Groups, Subgroups, Cyclic groups, Elementary properties of cyclic groups.

Sections: 2 to 6

MODULE II: PERMUTATIONS, COSETS, AND DIRECT PRODUCTS (20 hrs)

Groups of permutations, Cayley's Theorem, Orbits , Cycles and the alternating groups, Even and odd permutations, Cosets and the theorem of Lagrange, Direct products.

Sections: 8 to 10, 11.1and 11.2

MODULE III: HOMOMORPHISMS AND FACTOR GROUPS (25 hrs)

Homomorphisms, Properties of Homomorphisms, Factor groups, Fundamental Homomorphism Theorem, Normal Subgroups and inner automorphisms, Simple groups.

Sections: 13, 14, 15.14 to 15.18

MODULE IV: RINGS AND FIELDS (20 hrs)

Rings, Definitions and basic properties, Fields, Integral domains, Characteristic of a ring, Homomorphisms, Properties of homomorphism, Factor rings, Fundamental homomorphism theorem.

Sections: 18, 19, 26.

Text book:

Fraleigh, John. B. (2012). A **First Course in Abstract Algebra. (7th edition). Pearson.**

Reference :

1. **Herstein, I. N. (1975). Topics in Algebra . (2nd edition). Wiley.**
2. **Gallian, Joseph. A. (2010). Contemporary Abstract Algebra. (7th edition). Brooks / Cole.**
3. **Dubreil , P. & Dubreil-Jacotin, M. L. (1967). Lectures on Modern Algebra. New York : Hafner Publishing Company.**
4. **Archbold, J. W. (1972). Algebra. (4th edition). The English language Book Society and Pitman Publishing.**
5. **Artin, Michael. (2010). Algebra. (2nd edition). Pearson Education India.**

SEMESTER V

HUMAN RIGHTS AND MATHEMATICS FOR ENVIRONMENTAL STUDIES

Course Code: MM5CRT08
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I:
ENVIRONMENTAL POLLUTION (8 hrs)

Introduction- Definition, causes, effects and control/treatment methods of: (i) air pollution, (ii) water pollution, (iii) soil pollution, (iv) marine pollution, (v) noise pollution, (vi) Thermal pollution, (vii) nuclear hazards.

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

ENVIRONMENT IMPACT ASSESSMENT AND CONTROL (8 hrs)

Environmental ethics: Issues and possible solutions – Environment Protection Act- Air (Prevention and control of Pollution) Act- Water (Prevention and control of Pollution) Act- Wildlife Protection Act- Forest Conservation Act.

MODULE II: HUMAN RIGHTS (8 Hrs)

Human Rights-Concept, Origin and Definitions-Types of Human Rights-UNO and UDHR-Human Rights and Indian Constitution-Contemporary Human Rights Issues-Women Rights-Child Rights-Rights of Minorities and Dalit’s-HIV/AIDs-National and State Human Rights Commission.

MODULE III: ASTRONOMY- I (30 HRS)

Sphere, Great circle and small circle, Spherical Triangle, Polar triangle relation between them, Cosine formula, Sine Formula, Cotangent formula, Five parts formula, Half angels, Napirer’s analogies, Spherical Co-ordinates, Relation between spherical and rectangular coordianates .

MODULE IV: ASTRONOMY-II (36 Hrs)

Celestial sphere, Diurnal motion, Cardinal points, Hemispheres, Annual motion, Ecliptic, Obliquity, Celestial co-ordinate Change in the co-ordinates of the sun in the course of the year, Sidereal time, latitude of a place, Relation between them, Hour angle of a body at rising and setting Morning and evening star, Circumpolar star, Condition of circumpolar star, Diagram of the celestial sphere. Earth, The zones of earth, Variation in the duration of day and night, Condition of perpetual day.

Text books:

1. **Essential Environmental Studies S.P Misra, S.N Pandey (Ane Books Pvt Ltd)**
2. **Environmental Science: Principles and Practice- R.C. Das and D.K. Behera (PHI Pvt. Ltd)**
3. **Environmental chemistry and pollution control S.S Dara (S. Chand)**
4. **Text Book of Environmental Studies for undergraduate courses, Bharucha Erach (University Press, IInd Edition 2013)**
5. **Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.**
6. **Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)**
7. **Law Relating to Human Rights, Asia Law House, 2001.**
8. **S. Kumaravelu, Astronomy for degree classes.**

References

1. **Environmental Science G Tyler Miller (Cengage Learning)**
2. **Introduction to Environmental Science Y Anjaneyulu (B S Publications)**
3. **Introduction to Environmental engineering and science- G.M. Masters and W.P. Ela (PHI Pvt. Ltd)**
4. **Environmental management- B. Krishnamoorthy (PHI Pvt. Ltd)**
5. **Solar energy- fundamentals and applications- H.P. Garg and J. Prakash (Tata Mc Graw Hill).**
6. **Solar energy-fundamentals, design, modeling and applications- G.N. Tiwari (Narosa Pub. House).**
7. **B. Basu, An Introduction to Astrophysics.**
8. **S. Hofkings, A Brief History of Time.**
9. **J.V. Narlikar, Introduction to cosmology.**

SEMESTER V
OPEN COURSE - FOUNDATIONS OF MATHEMATICS

Course Code: MM5OPT01
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 3

Open Course

MODULE I: SET THEORY, RELATIONS AND FUNCTIONS (18 hours)

Set Theory: Introduction, Sets and Elements, Subsets, Universal Set, Empty Set, Venn Diagrams, Set Operations-Union and Intersection, Complements Differences Symmetric differences

Relation: Introduction, Product Sets, Relations, Pictorial Representatives of Relations

Function: Introduction, Functions, One To One, Onto and Invertible Functions.

Text 1: Chapter 1: Sections: 1.1 to 1.4
Chapter 2: Sections: 2.1 to 2.4
Chapter 3: Sections: 3.1 to 3.3

MODULE II: LOGIC (18 hours)

Introduction ,Propositions and Compound Statements, Basic Logical Operations, Conjunction, disjunction, Negation, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Conditional and Biconditional Statements

Text 1: Chapter 4: Sections: 4.1 to 4.6, 4.8

MODULE III: PERMUTATION AND COMBINATION (18 hours)

Introduction, Basic Counting Principles, Mathematical Functions**,** Permutations, Permutations with Repetitions, Ordered Samples, Combinations, The Pigeonhole Principle.

Text 1: Chapters 5: Sections: 5.1 to 5.6

MODULE IV: EQUATIONS, INEQUALITIES AND LINEAR PROGRAMMING (18 hours)

Equations: identities, linear equations, Application of Linear Equations, Quadratic Equations, Solution by factoring, Completing the square, Applications of quadratic equations

Inequalities: basic properties, Properties of Inequalities, System of Equations in two variables (non linear system excluded) Inconsistent and dependent systems, System of Linear Inequalities and Linear Programming

Text 2: Chapter 3: Sections 3 to 6
Chapter 4: Section 1
Chapter 8: Section 1 and 6

Text Books:

1. **Lipschutz, Seymour. & Lipson, Marc. Lars. (2007). Discrete Mathematics - Schaums Outline Series. (3rd edition). Tata McGraw-Hill Limited.**
2. **Price, Justin, J. & Flanders, Harley. (1982). College Algebra. Holt, Rinehart & Winston of Canada Ltd.**

Reference:

1. **Guha, Abhijit. (2011). Quantitative Aptitude for competitive Examinations. (4th edition). Tata McGraw-Hill Limited.**
2. **Aggarwal, R. S. (2012). Quantitative Aptitude. (7th edition). S Chand and Company Limited.**

SEMESTER VI

REAL ANALYSIS – II

Core - 9

Course Code: MM6CRT09
Teaching hours: 6 Hrs/ week (Hrs / Sem: 108)
Credits: 4

MODULE I: CONTINUOUS FUNCTIONS (25 Hrs)

Continuous functions, Combinations of continuous functions, Continuous functions on intervals, Uniform continuity, Monotone and inverse functions.

Chapter 5: Sections: 5.1 to 5.4, 5.6.

MODULE II: DIFFERENTIATION (25 Hrs)

The derivative, The mean value theorem, L'Hospital rules, Taylor's theorem.

Chapter: 6

MODULE III: THE RIEMANN INTEGRAL (35 Hrs)

The Riemann integral, Riemann integrable functions, The fundamental theorem, Approximate integration.

Chapter 7

MODULE IV: SEQUENCES AND SERIES OF FUNCTIONS (23 Hrs)

Pointwise and uniform convergence, Interchange of limits, Series of functions.

Chapter: 8 Sections: 8.1, 8.2
Chapter: 9 Section: 9.4

Text Book:

Bartle, Robert. G. & Sherbert, Donald. R. (2007). Introduction to Real Analysis. (3rd edition). Wiley.

Reference:

1. **Malik, S.C. & Arora, Savita. Mathematical Analysis. (4th edition). New Age International Publishers.**
2. **Narayan, Shanti & Raisinghania, M.D. Elements of Real Analysis. S Chand and Company Ltd.**
3. **Rudin, Walter. Real and Complex analysis. (3rd edition). McGraw Hill International Edition.**
4. **Taylor, Angus. E. (1995). Advanced Calculus. Ginn and company.**

SEMESTER VI
COMPLEX ANALYSIS

Core - 10

Course Code: MM6CRT10
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: ANALYTIC FUNCTIONS (30 Hrs)

Functions of a complex variable, Limits, Theorems on limits, Continuity, Derivatives, Differentiation formulas, Cauchy Reimann Equations, Sufficient conditions 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 Hrs)

Derivatives of functions, Definite integrals of functions, Contours, Contour integrals, Some examples, Upper bounds for moduli of contour integrals, Anti derivates, Cauchy-Goursat theorem (without proof), Simply connected domains, Multiply connected domains, Cauchy integral formula, An extension of Cauchy integral formula, Some consequences of the extension, Liouville's theorem and fundamental theorem of algebra, maximum modulus principle.

Chapter 4: Sections: 37 to 41, 43, 44, 46, 48 to 54

MODULE III: SERIES (15 Hrs)

Convergence of sequences and series, Taylor series, Proof of Taylor's theorem, Examples, Laurent's series (without proof), Examples.

Chapter 5: Sections: 55 to 60 and 62

MODULE IV: RESIDUES AND POLES (20 Hrs)

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 6: Sections: 68 to 70 and 72 to 74
Chapter 7: Sections: 78 to 81 and 85

Text books:

Brown, James. Ward. & Churchill, Ruel. V. Complex variables and applications. (8th edition). Tata Mc Graw Hill Limited.

Reference:

1. **Karunakaran, V. (2005). Complex Analysis. Alpha Science International.**
2. **Ahlfors, Lars. V. Complex Analysis - An Introduction to the Theory of Analytic Functions of one Complex Variables. (4th edition). Mc-Graw-Hill Limited.**
3. **Mathews, John. H. & Howell, Russell. W. (2011). Complex Analysis for Mathematics and Engineering. (6th edition). India: Jones and Bartlett India Pvt Ltd.**
4. **Rudin, Walter. Real and Complex analysis. (3rd edition). McGraw Hill International Edition.**

SEMESTER VI
LINEAR ALGEBRA AND METRIC SPACES

Course Code: MM6CRT11
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

Core - 11

MODULE I: VECTOR SPACES (25 Hrs)
Vector spaces, Definitions, Properties, Subspace, Sum and direct sum, Finite dimensional vector space, Span and linear independence, Bases , Dimension.
Text 1: Chapter:1, 2

MODULE II: LINEAR MAPS (30 Hrs)
Linear maps, Definitions and examples, null spaces and ranges, matrix of a linear map, invertibility.
Text 1: Chapter 3

MODULE III: METRIC SPACES - I (18 Hrs)
Definition and examples of metric spaces, Open spheres and closed spheres, Neighbourhoods, Open sets, Interior points, Closed sets, Limit points and isolated points, Closure of a set, Boundary Points, Distance between Sets and Diameter of a set, Subspace of a metric Space, Product Metric Space.
Text 2: Chapters 2: Sections: 2.1 to 2.4, 2.6 to 2.13

MODULE IV: METRIC SPACES - II (17 Hrs)
Convergent sequences, Cauchy sequences, Complete spaces, Continuous Functions - definitions and characterisations, Uniform continuity.
Text 2: Chapters 3: Sections: 3.1 to 3.3
Chapters 4: Sections: 4.1, 4.3

Text Books:

1. **Axler, Sheldon. (1997). Linear Algebra Done Right. Springer.**
2. **Jain, Pawan. K. & Ahmad, Khalil. (2012). Metric Spaces. Narosa Publishing House.**

Reference:

1 **Bronson, Richard. &Costa, Gabriel. B. (2009). Linear Algebra an Introduction. (2nd edition). Academic Press, Elsevier.**
2 **Strang, Gilbert. Linear Algebra And Its Applications. (3rd edition). Book World Enterprises.**
3 **Simmons, G. F. Introduction to Topology and Modern analysis. Tata McGraw Hill.**
4 **Searcoid, Micheal. O. (2007). Metric Spaces. Springer.**

SEMESTER VI

DISCRETE MATHEMATICS AND NUMERICAL METHODS

Course Code: MM6CRT12

Core - 12

Teaching hours: 6 Hrs/week (Hrs / Sem: 108)

Credits: 4

MODULE I : GRAPH THEORY-I (30Hrs)

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

Text 1: Chapter 1 (Sections 1.1, 1.3 to 1.7)

MODULE II: GRAPH THEORY-II (30 Hrs)

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

Text 1: Chapter 2 (Sections 2.1, 2.2 & 2.3, 2.6); Chapter 3 (Sections 3.1 (algorithm deleted), 3.2 (algorithm deleted), 3.3, and 3.4 (algorithm deleted)).

MODULE III: INTRODUCTION TO CRYPTOGRAPHY (30 Hrs)

Caesar Cipher, Vigenere's Cipher, Hill Cipher, Verman's Telegraph cipher, RSA Algorithm, Knapsack problem, the Knapsack Cryptosystem.

Text 2: Chapter 10: Sections 10.1, 10.2

MODULE IV: NUMERICAL ANALYSIS (28Hrs)

Introduction, Graphical solution of equations, method of bisection, Iteration method, Newton - Raphson method, Regula- Falsi method , Solutions of Linear equations, Gauss elimination method, Jacobi's method, Gauss Seidel Iteration method, Crout's triangularisation method.

Text 2: Chapter 2: Sections: 2.1 to 2.5, 2.7
Chapter 11: Sections: 11.2 to 11.4

Text books:

1. **1. John Clark Derek Allen Holton - A first look at graph theory, Allied Publishers**
2. **David M Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd, 2009.**

3. G Shanker Rao, Numerical Analysis, New Age International Publisers, Fourth Edition, 2010.

Reference:

1. **J ABondy and U S R Murty, Graph theory with applications, The Macmillian Press Limited,1997.**
2. **John Clark Derek and Allen Holton, A first look at graph theory, Allied Publishers.**
3. **R Balakrishnan and K Ranganathan, A textbook of Graph Theory, Springer International Edition.**
4. **Sankara Rao, Numerical methods for Scientist and Engineers, PHI, 2007**
5. **Amos Gilat, Numerical methods for Engineers and Scientist, Wiley, 2014**

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CHOICE BASED COURSE)

(DURING THE SIXTH SEMESTER)

SEMESTER VI
OPERATIONS RESEARCH

Course Code: MM6CBT01
Teaching hours: 3 Hrs/ week (Hrs / Sem: 54)
Credits: 3

MODULE I: MATHEMATICAL PRELIMINARIES (10 HRS)

Vectors and vector spaces , Linear Dependence, Dimension of a vector space, basis, Euclidean Space, Norm of a vector, Open and closed sets in E_n, Convex linear combinations, convex sets, Convex hull of a set, Vertices or extreme points of a convex set; Convex polyhedron, Hyperplanes, half spaces and polytopes, Separating and Supporting Hyperplanes; Vertices of a closed bounded convex set

Text 1: Chapter 1: Sections: 1 to 5 and 11 to 18
(Definitions and examples only. Proofs of all theorems are excluded)

MODULE II: LINEAR PROGRAMMING (5HRS)

General LPP, Feasible solution, Basic solutions, Basic feasible solutions, optimal solutions, Simplex method, Canonical form of equations, Simplex method (numerical example).

Text 1: Chapter 3: Sections: 3 to 11
(All Theorems without proof)

MODULE III: LINEAR PROGRAMMING CONTD. (21HRS)

Simplex tableau, Finding the first b.f.s., artificial variables, Degeneracy, Duality in LPP, Duality Theorems, Applications of duality, Dual simplex method.

Text 1: Chapter 3: Sections: 12 to 14, 17 to 20
(Proofs of theorem 7, 8, 9, 10 and 11 are excluded)

MODULE IV: TRANSPORTATION AND ASSIGNMENT PROBLEMS (18 HRS)

Introduction, transportation problem, Transportation array, Transportation matrix, triangular basis (excluding the theorem), finding a basic feasible solution, testing of optimality, loop in a transportation array (definition only), changing the basis, Degeneracy, Unbalanced problem, Assignment problem.

Text 1: Chapter 4: Sections: 1 to 11 and 14
Text 2: Chapter 10: Section: 8

Text Books:

1. **Mittal, K. V. & Mohan, C. Optimization Methods in Operations Research and System Analysis. (3rd edition). New Age International.**

Reference:

1. **Gupta, Prem. Kumar. & Hira, D. S. (2009). Operations Research. S Chand and Company Limited. (5th edition).**
2. **Sinha, S. M. (2006). Mathematical Programming. (1st edition). Elsevier.**
3. **Sharma, J. K. (2010). Operations Research. (4th edition). MacMillian Publishers India Ltd.**

SEMESTER VI
FUZZY MATHEMATICS

Course Code: MM6CBT02
Teaching hours: 3 Hrs/ week (Hrs / Sem: 54)
Credits: 3

MODULE I: INTRODUCTION (10 Hrs)

Introduction , Crisp Sets: An Overview ,Fuzzy Sets: Basic Types ,Fuzzy Sets: Basic concepts. Additional properties of α cuts, Representation of fuzzy sets, Extension principle of fuzzy sets.

Chapter 1 : Sections: 1.1 to 1.4
Chapter 2 : Sections: 2.1 to 2.3

MODULE II : OPERATIONS ON FUZZY SETS: (15 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 to 3.5

MODULE III: FUZZY ARITHMETIC (10 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 to 4.6

MODULE IV: FUZZY LOGIC (19 Hrs)

Classical Logic: An Overview , Multivalued Logics , Fuzzy propositions, Fuzzy quantifiers ,Linguistic Hedges, Inference from Conditional Fuzzy propositions .

Chapter 8 : Sections: 8.1 to 8.6

Text Book:

1. **Klir, George. J. & BoYuan. (2000). Fuzzy Sets and Fuzzy Logic Theory and Applications'. New Delhi: Prentice Hall of India Private Limited.**

Reference:

1. **Klir, G. J. & Folger, T. (1988). Fuzzy Sets, Uncertainty and Information. New Delhi: Prentice Hall of India Private Limited.**
2. **Zimmermann, H. J. (1996). Fuzzy Set Theory- and its Applications. Allied Publishers.**

SEMESTER VI
TOPOLOGY

Course Code: MM6CBT03
Teaching hours: 3 Hrs/ week (Hrs / Sem: 54)
Credits: 3

MODULE I **(20 Hours)**
Topological Spaces, Basis for a Topology,
The product Topology on X x Y, The Subspace Topology.

MODULE II **(17 Hours)**
Closed sets and Limit Points, Continuous functions, The Metric Topology

MODULE III **(12 Hours)**
Connected Spaces, Connected subspaces in the Real Line

MODULE IV **(5 Hours)**
Compact Spaces
Chapter 2 : Sections 12, 13, 15, 16, 17, 18, 20
Chapter 3: Sections 23,24, 26

Text books:
1. **Munkers, James. R. (2006). Topology. Pearson Prentice Hall Limited.**

Reference :
1. **Simmons, G. F. Introduction to Topology and Modern Analysis. TMH.**

B.Sc. DEGREE PROGRAMME
COMPLEMENTARY COURSES FOR
B.Sc. PHYSICS AND
B.Sc. CHEMISTRY

SEMESTER I

MATHEMATICS – I-Partial Differentiation, Matrices, Trigonometry and Numerical Methods

Course Code: MM1CMT01
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 3

<u>**Use of Non Programmable Scientific Calculator is Permitted**</u>

MODULE I: PARTIAL DIFFERENTIATION (12 hrs)

Functions of several variables (Definitions only), Partial derivatives, Functions of more than two variables, Partial Derivatives and continuity, Mixed derivative theorem, Differentiability, The Chain Rule, Implicit differentiation revisited, Functions of many variables.

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

MODULE II: MATRICES (23 hrs)

Some Types of Matrices: Identity Matrix, Special square matrices, The inverse of a matrix, The transpose of a matrix, Symmetric matrices, The Conjugate of a matrix, Hermitian Matrices, Direct Sum.

Equivalence: The rank of matrix, Elementary Transformations, The inverse of an Elementary transformation, Equivalent matrices, Row Equivalence, Normal Form of a Matrix, Elementary Matrices.

Linear Equations: Definitions, Solution using a matrix, Non Homogeneous Equations, Homogeneous Equations.

The Characteristic Equation of a matrix: The Characteristic Equation, General Theorems

Lamda Matrices: Cayley Hamilton Theorem

Text 2: Relevant Sections of Chapter 2, 5, 10, 19 and 23
(All theorems without proofs)

MODULE III: TRIGONOMETRY (23hrs)

Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, $\sin^n\theta$, $\cos^n\theta$, $\sin^n\theta\cos^m\theta$, Exponential series for complex quantities, Circular functions for complex angles, Periods of complex circular functions, Hyperbolic Functions, Inverse circular functions, Inverse hyperbolic functions, Summation of Series.

Text 3: Chapter III: Sections: 27 and 28
Chapter IV: Sections: 43 to 47
Chapter V: Sections 56 to 79
Chapter VIII: Section 103 to 109

MODULE 1V: NUMERICAL METHODS **(14 Hrs)**

Bisection method, Method of false position, Iteration method, Aitken's Δ^2 -process, Newton - Raphson method, Generalized Newton's method.

Text 4: Chapter 2: Sections 2.1 to 2.5

Text Books:

1. **Thomas, George. (2008). B. Jr, Thomas' Calculus. 12th Edition, Pearson.**
2. **Ayres, Frank. Jr. Matrices. Schaum's Outline Series. TMH Edition.**
3. **Loney, S.L. (2009). Plane Trigonometry Part – II. AITBS Publishers India.**
4. **Sastry, S.S. Introductory methods of Numerical Analysis. 4th edition, Prentice Hall.**

Reference:

1. **Narayan, Shanti. Differential Calculus. S Chand & Company.**
2. **Thomas, George. B. Jr. & Finney, Ross. L. Calculus, LPE, 9th Edition, Pearson Education.**
3. **Narayanan, Shanthi. & Mittal, P.K. A Text Book of Matrices. S. Chand.**
4. **Lewis, David. W. Matrix Theory. Allied.**
5. **Ahamad, Quazi. Shoeb. Numerical and Statistical Techniques. Ane Books.**

SEMESTER II

MATHEMATICS – II-Integral Calculus, Ordinary and Partial Differential Equations

Course Code: MM2CMT02
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 3

MODULE I: INTEGRAL CALCULUS (15 hrs)

Substitution and area between curves, Volumes using cross sections (disc method only), Arc Length, Length of a curve $y = f(x)$, The differential formula for arc length, Areas of surfaces of revolution

Text 1: Chapter 5: Section: 5.6
Chapter 6: Sections: 6.1, 6.3, 6.4

MODULE II: MULTIPLE INTEGRALS (17 hrs)

Double and iterated integrals over rectangles, Fubini's theorem for calculating Double integrals, Double integrals over general regions, Properties of double integrals, Area by double integration, Areas of bounded regions in the plane, Triple integrals in rectangular co-ordinates, Average value of function in space.

Text 1: Chapter 15: Sections 15.1 to 15.3, 15.5

MODULE III: ORDINARY DIFFERENTIAL EQUATIONS (20 Hrs)

Separable Variables, Exact Differential Equation, Linear Equations, Solutions by Substitutions

Text 2: Chapter 2

MODULE IV: PARTIAL DIFFERENTIAL EQUATIONS (20 Hrs)

Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Partial differential equations, Origins of first order partial differential equations, Linear equations of the first order.

Text 3: Chapter 1: Section 3
Chapter 2: Sections: 1, 2 and 4
(Proofs of all theorems in module IV are excluded)

Text Books:

1. **Thomas, George. B. Jr, Thomas' Calculus. 12th Edition. Pearson.**
2. **Siddiqi, A. H. & Manchanada, P. (2006). A first Course in Differential Equations with Applications. Macmillan India Ltd.**
3. **Sneddon, Ian. Elements of Partial Differential Equation. Tata McGraw Hill.**

Reference:

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

SEMESTER III

MATHEMATICS – III-Vector Calculus, Analytic Geometry and Abstract Algebra

Course Code: MM3CMT03
Teaching hours: 5Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: VECTOR VALUED FUNCTIONS (15hrs)

Curves in Space and Their tangents, Limits and continuity, derivatives and motion, Vector functions of constant length, Arc length in space, Unit tangent vector, Curvature and Normal Vectors of a curve, Circle of curvature for plane curves, Curvature and normal vectors for space curves, Directional Derivatives and Gradient Vectors, Gradients and tangent to level curves, functions of three variables.

Text 1: Chapter 13: Sections 13.1, 13.3 and 13.4
Chapter 14: Section 14.5

MODULE II: INTEGRATION IN VECTOR FIELDS (20 hours)

Line integrals(exclude mass and moment calculations), Vector fields and line integrals: work circulation and flux, Line integrals of vector fields, Work done by a force over a curve in space, Path independence, conservative fields and potential functions, Green's theorem in the plane(Statement and problems only), Surface integrals (exclude moments and masses of thin shells), Stokes' theorem (Statement and problems only), The Divergence theorem and a unified theory (Statement and problems only).

Text 1: Chapter 16: Sections: 16.1 to 16.4, 16.6 to 16.8

MODULE III: ANALYTIC GEOMETRY (25 hrs)

Polar coordinates ,Polar equations and graphs, Conic sections, Parabolas, Ellipses, Hyperbolas, Conics in Polar coordinates, Eccentricity, Polar equations

Text 1: Chapter 11: Sections 11.3, 11.6, 11.7

MODULE IV: ABSTRACT ALGEBRA (30 hrs)

Groups, Elementary properties of groups, Finite groups and tables, Subgroups, Cyclic groups, Elementary properties of cyclic groups, Subgroups of finite cyclic groups, Groups of Permutations, Homomorphism, Rings and Fields.

Text 2: Chapter 1: Sections: 4 to 6
(Proofs of theorems 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 to 13.3
Chapter 6: Sections: 18.1 to 18.5, 18.14 to 18.18

Text Books: -

1. **Thomas, George. B. Jr, Thomas' Calculus. 12th Edition, Pearson.**
2. **Fraleigh, John. B. (2012). A First course in Abstract Algebra. 7th Edition. Pearson.**

Reference:

1. **Anton, Howard. Bivens, Irl. & Davis, Stephen. (2015). Calculus. International student Version. 10th Edition. Wiley.**
2. **Kreyszig, Erwin. (2015). Advanced Engineering Mathematics. International student Version. 10th Edition. Wiley.**
3. **Herstein, I.N. (1975) Topics in Algebra. 2nd Revised Edition. John Wiley and Sons.**
4. **Gallian, Joseph. A. A Contemporary Abstract Algebra. Narosa Publishing House.**

SEMESTER IV

MATHEMATICS – IV-Fourier Series, Laplace Transforms and Linear Algebra

Course Code: MM4CMT04
Teaching hours: 5 Hrs/ week (Hrs / Sem: 90)
Credits: 4

MODULE I: FOURIER SERIES (25 hrs)

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

Text 1: Sections: 10.1 to 10.4

MODULE II: LAPLACE TRANSFORMS (25 hrs)

Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential equations, Initial value problems, Differentiation and Integration of Transforms, Differential Equation with variable coefficients, Laplace Transform: General formula (relevant formulae only), Table of Laplace Transforms (relevant part only)

Text 1: Sections 5.1, 5.2, 5.4, 5.8 and 5.9
(Proofs of all theorems in module II are excluded)

MODULE III: VECTOR SPACES (20 hrs)

Vectors, Subspaces, Linear independence, Basis and dimension, Row space of a matrix.

Text 2: Chapter 2: Sections 2.1 to 2.5
(Proofs of all lemmas and theorems in module III are excluded)

MODULE IV: LINEAR TRANSFORMATION (20 hrs)

Functions, Linear transformations, Matrix representations, Change of basis, Properties of linear transformations.

Text 2: Chapter 3: Sections 3.1 to 3.5
(Proofs of all theorems in module IV are excluded)

Text Books:

1. **Kreyszig, Erwin. Advanced Engineering Mathematics. 8th Edition. India. Wiley.**
2. **Bronson, Richard. & Costa, Gabriel. B. (2009). Linear Algebra an Introduction, 2nd Edition, Academic Press. Elsevier.**

Reference:

1. **Grewal, B.S. (2015). Higher Engineering Mathematics. 43rd Edition. Khanna Publishers.**
2. **Bali, N. P. and Goyal, Manish. (2014). A Text Book of Engineering Mathematics. Laxmi Publications Limited.**
3. **Kumaresan, S. (1999). Linear Algebra. A Geometric Approach. New Delhi. Prentice Hall of India.**
4. **Gilbert, Jimmie. & Gilbert, Linda. (2013). Linear Algebra and Matrix Theory. Elsevier.**

B.Sc. DEGREE PROGRAMME
COMPLEMENTARY COURSES FOR
B.Sc. COMPUTER SCIENCE

SEMESTER I

DISCRETE MATHEMATICS – I-RELATIONS, LOGIC AND PROPOSITIONAL CALCULUS, LATTICES AND BOOLEAN ALGEBRA

Course Code: MM1CSMT1
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 4

MODULE I: RELATIONS (18 hrs)

Introduction, Product Sets, Relations, Pictorial Representatives of Relations, Composition of Relations, Types of Relations, Closure Properties, Equivalence Relations, Introduction, Ordered Sets, Hasse Diagrams of Partially Ordered sets, Maximal and Minimal, and First and Last Elements.

Chapter 2: Sections: 2.1 to 2.8
Chapter 13: Sections: 13.1 to 13.3

MODULE II: LOGIC AND PROPOSITIONAL CALCULUS (15 hrs)

Introduction, Propositions and Compound Statements, Basic Logical Operations, Conjunction, Disjunction, Negation, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Biconditional Statements, Arguments.

Chapter 4: Sections: 4.1 to 4.9

MODULE III: LATTICES (15 hrs)

Lattices, Lattices and Order, Sub lattices, Isomorphic Lattices, Bounded Lattices, Distributive Lattices, Join Irreducible Elements, Atoms, Complements, Complemented Lattices

Chapter 13: Sections: 13.8 to 13.11

MODULE IV: BOOLEAN ALGEBRA (24 hrs)

Introduction, Basic Definitions, Duality, Basic Theorems, Boolean Algebras as Lattices, Representation Theorem, Sum-of-Products Form for Sets, Sum-of-Products Form for Boolean Algebras, Minimal Boolean Expressions, Prime Implicants, Logic Gates and Circuits, Truth Tables, Boolean Functions, Karnaugh Maps.

Chapter 14: Sections: 14.1 to 14.12

Text Book

Lipschutz, Seymour. & Lipson, Marc. Lars. (2007) Discrete Mathematics. 3rd Edition. Schaum's Outline Series McGraw Hill.

Reference:

1. **Rosen, Kenneth. H. Discrete Mathematics and Its Applications. 6th Edition. Tata McGraw-Hill Publishing Company Limited.**
2. **Sharma, J. K. Discrete Mathematics. 3rd Edition. McMillan Publishers India Ltd.**
3. **Grimaldi, Ralph. P. & Ramana, B.V. Discrete And Combinatorial Mathematics. Pearson Education. Dorling Kindersley India Pvt. Ltd.**

SEMESTER II
DISCRETE MATHEMATICS - II-MATRICES, NUMBER THEORY AND GRAPH THEORY

Course Code: MM2CSMT2
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 4

MODULE I: MATRICES (20 hrs)

Some Types of Matrices: Identity Matrix, Special square matrices, The inverse of a matrix, The transpose of a matrix, Symmetric matrices, The Conjugate of a matrix, Hermitian Matrices, Direct Sum

Equivalence : The rank of matrix , Elementary Transformations, The inverse of an Elementary transformation, Equivalent matrices, Row Equivalence, Normal Form of a Matrix, Elementary Matrices

Linear Equations: Definitions, Solution using a matrix, Non Homogeneous Equations, Homogeneous Equations

The Characteristic Equation of a matrix: The Characteristic Equation, General Theorems

Lamda Matrices: Cayley Hamilton Theorem

Text 1: Relevant Sections of Chapter 2, 5, 10, 19 and 23
(All theorems without proofs)

MODULE II: NUMBER THEORY (19 hrs)

Introduction, Order and Inequalities, Absolute Value, Mathematical Induction, Division Algorithm, Divisibility, Primes, Greatest Common Divisor, Euclidean Algorithm, Fundamental Theorem of Arithmetic, Congruence relation, Congruence equations.

Text 2: Chapter 11: Sections: 11.1 to 11.9
(All theorems without proofs)

MODULE III: GRAPH THEORY-I (18 hrs)

Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, The matrix representation of graphs, Fusion.

Text 3: Chapter 1: Sections: 1.1, 1.3 to 1.8
(All theorems without proof)

MODULE IV: GRAPH THEORY-II (15 hrs)

Trees, Definitions and Simple properties, Bridges, Spanning trees, Connector Problems, Weighted graph, minimal spanning tree, Kruskal’s Algorithm, Prim’s Algorithm, Shortest Path problems, the Breadth First Search Algorithm, back-tracking algorithm for a shortest path, back- tracking algorithm for the number of shortest paths, Dijkstra’s algorithm.

Text 3: Chapter 2: Section Sections: 2.1, 2.2, 2.3, 2.4, 2.5
(All theorems without proof)

Text Books

1. **Ayres, Frank. Jr. Matrices. Schaum's Outline Series. Tata MacGraw Hill Edition.**
2. **Lipschutz, Seymour. & Lipson, Marc. Lars. (2007). Discrete Mathematics. 3rd Edition, Schaum's Outline Series. McGraw-Hill.**
3. **Clark, John. & Holton, Derek. Allen. A first look at graph theory. Allied Publishers.**

Reference:

1. **Rosen, Kenneth. H. Discrete Mathematics and its Applications, 6th Edition. Tata McGraw-Hill Publishing Company Limited.**
2. **Sharma, J. K. Discrete Mathematics, 3rd Edition, McMillan Publishers India Ltd.**
3. **Burton, David. M. Elementary Number Theory, 7th Edition, McGraw Hill Education (India) Private Ltd.**
4. **Narayan, Shanti. Matrices. S Chand and Company.**

SEMESTER III
BASIC STATISTICS AND PROBABILITY THEORY

Course Code: MM3CSMT3
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 4

Module I : Collection of data, and its Presentation
Introduction to Statistics, population and sample, collection of data, census and sampling, Methods of sampling- simple random sampling (with and without replacement), stratified sampling, systematic sampling (methods only), Types of data – quantitative and qualitative, classification and tabulation, diagrammatic representation - bar diagram, pie diagram; histogram; frequency polygon; frequency curve; ogives and stem and leaf chart. (And simple problems based on the above topics). (18L)

Module II : Descriptive Statistics
Measures of central tendency- mean, median, mode, geometric mean, harmonic mean, percentiles, deciles. Measures of dispersion - range, quartile deviation, mean deviation, standard deviation, coefficient of variation. Box Plot. (And simple problems based on the above topics). (18L)

Module III: Probability
Random experiment, sample space, events, probability measure . Approaches to probability – classical , statistical and axiomatic. Addition theorem (upto 3 events), Conditional probability, Independence of events, Multiplication theorem (upto 3 events), Total probability law, Bayes' Theorem (without proof). (And simple problems based on the above topics). (16L)

Module IV: Probability Distributions
Random variables and cumulative (probability) distribution functions, probability density (mass) function, Expectation of a random variable, mean and standard deviation and moment generating function, Theoretical distributions, Discrete distributions-binomial and Poisson- mean, variance and moment generating functions, Continuous distributions-normal distribution only-mean, variance and properties. Area under the normal curve-related problems, Central limit theorem (without proof), And simple problems based on the above topics). (20L)

References
1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

4. Robert V. Hogg, Elliot A. Tanis and Jagan Mohan Rao, Probability and Statistical Inference, Pearson Publishers
5. Robert V. Hogg, Joseph Mckean and Allen T. Craig, Introduction to Mathematical Statistics Pearson Publishers
6. Irwin Miller and Marylees Miller, Pearson Publishers Mathematical Statistics with Applications,
7. J. Medhi, Statistical Methods New Age International

B.Sc. DEGREE PROGRAMME
COMPLEMENTARY COURSES FOR BCA

SEMESTER I

DISCRETE MATHEMATICS – I-RELATIONS, LOGIC AND PROPOSITIONAL CALCULUS, LATTICES AND BOOLEAN ALGEBRA

Course Code: MM1CAMT1
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 4

Text Book
Seymour Lipschutz and Marc Lars Lipson, Discrete Mathematics, Third Edition, Schaum's Outline Series, McGraw-Hill, 2007.

MODULE I: RELATIONS (18 hrs)
Introduction, Product Sets, Relations, Pictorial Representatives of Relations, Composition of Relations, Types of Relations, Closure Properties, Equivalence Relations, Introduction, Ordered Sets, Hasse Diagrams of Partially Ordered sets, Maximal and Minimal, and First and Last Elements.
Chapter 2: Sections: 2.1 to 2.8
Chapter 13: Sections: 13.1 to 13.3

MODULE II: LOGIC AND PROPOSITIONAL CALCULUS (15 hrs)
Introduction, Propositions and Compound Statements, Basic Logical Operations, Conjunction, Disjunction, Negation, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Biconditional Statements, Arguments.
Chapter 4: Sections: 4.1 to 4.9

MODULE III: LATTICES (15 hrs)
Lattices, Lattices and Order, Sub lattices, Isomorphic Lattices, Bounded Lattices, Distributive Lattices, Join Irreducible Elements, Atoms, Complements, Complemented Lattices
Chapter 13: Sections: 13.8 to 13.11

MODULE IV: BOOLEAN ALGEBRA (24 hrs)
Introduction, Basic Definitions, Duality, Basic Theorems, Boolean Algebras as Lattices, Representation Theorem, Sum-of-Products Form for Sets, Sum-of-Products Form for Boolean Algebras, Minimal Boolean Expressions, Prime Implicants, Logic Gates and Circuits, Truth Tables, Boolean Functions, Karnaugh Maps.
Chapter 14: Sections: 14.1 to 14.12

Reference:

1. **Rosen, Kenneth. H. Discrete Mathematics and Its Applications. 6th Edition. Tata McGraw-Hill Publishing Company Limited.**
2. **Sharma, J. K. Discrete Mathematics. 3rd Edition. McMillan Publishers India Ltd.**
3. **Grimaldi, Ralph. P. & Ramana, B.V. Discrete And Combinatorial Mathematics. Pearson Education. Dorling Kindersley India Pvt. Ltd.**

SEMESTER II
DISCRETE MATHEMATICS - II-MATRICES, NUMBER THEORY AND GRAPH THEORY

Course Code: MM2CAMT2
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 4

Text Books

1. **Ayres, Frank. Jr. Matrices. Schaum's Outline Series, Tata Mac Graw Hill Edition.**
2. **Lipschutz, Seymour. & Lipson, Marc. Lars. (2007). Discrete Mathematics. 3rd Edition. Schaum's Outline Series, McGraw-Hill.**
3. **Clark John & Holton, Derek. Allen. A first look at graph theory. Allied Publishers.**

MODULE I: MATRICES (20 hrs)

Some Types of Matrices: Identity Matrix, Special square matrices, The inverse of a matrix, The transpose of a matrix, Symmetric matrices, The Conjugate of a matrix, Hermitian Matrices, Direct Sum

Equivalence : The rank of matrix , Elementary Transformations, The inverse of an Elementary transformation, Equivalent matrices, Row Equivalence, Normal Form of a Matrix, Elementary Matrices

Linear Equations: Definitions, Solution using a matrix, Non Homogeneous Equations, Homogeneous Equations

The Characteristic Equation of a matrix: The Characteristic Equation, General Theorems

Lamda Matrices: Cayley Hamilton Theorem

Text 1: Relevant Sections of Chapter 2, 5, 10, 19 and 23
(All theorems without proofs)

MODULE II: NUMBER THEORY (19 hrs)

Introduction, Order and Inequalities, Absolute Value, Mathematical Induction, Division Algorithm, Divisibility, Primes, Greatest Common Divisor, Euclidean Algorithm, Fundamental Theorem of Arithmetic, Congruence relation, Congruence equations.

Text 2: Chapter 11: Sections: 11.1 to 11.9
(All theorems without proofs)

MODULE III: GRAPH THEORY-I (18 hrs)

Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, The matrix representation of graphs, Fusion.

Text 3:Chapter 1: Sections: 1.1, 1.3 to 1.8
(All theorems without proof)

MODULE IV: GRAPH THEORY-II (15 hrs)

Trees, Definitions and Simple properties, Bridges, Spanning trees, Connector Problems, Weighted graph, minimal spanning tree, Kruskal's Algorithm, Prim's Algorithm, Shortest Path problems, the Breadth First Search Algorithm, back-tracking algorithm for a shortest path, back- tracking algorithm for the number of shortest paths, Dijkstra's algorithm.

Text 3: Chapter 2: Section Sections: 2.1, 2.2, 2.3, 2.4, 2.5
(All theorems without proof)

Reference:

1. **Rosen, Kenneth. H. Discrete Mathematics and its Applications, 6th Edition. Tata McGraw-Hill Publishing Company Limited.**
2. **Sharma, J. K. Discrete Mathematics, 3rd Edition, McMillan Publishers India Ltd.**
3. **Burton, David. M. Elementary Number Theory, 7th Edition, McGraw Hill Education (India) Private Ltd.**
   Narayan, Shanti. Matrices. S Chand and Company

SEMESTER IV

OPERATIONS RESEARCH

Course Code: MM4CAMT3
Teaching hours: 4 Hrs/ week (Hrs / Sem: 72)
Credits: 4

Text Book:
Gillet, Belly. E. Introduction to Operations Research A Computer Oriented Arithmetic Approach. Tata Mc Graw Hill.

MODULE I : BASICS OF O.R (10hrs)

The nature and uses of O.R- match concepts and approaches of O.R- models in O.R.

MODULE II: LINEAR PROGRAMMING PROBLEMS (25 hrs)

Mathematical formulation of a L.P.P, General linear programming problems, Solution of a L.P.P, Graphical method for solving a L.P.P.
Simplex Method: Stack and surplus variables- reduction of any feasible solution to a basic feasible solution. Unbounded solution. Optimality conditions- artificial variable techniques- Big M method.

MODULE III : TRANSPORTATION & ASSIGNMENT PROBLEMS (20 hrs)

Transportation model- solution by simplex method- north west corner rule, lowest cost entry method, Vogel method, MODI method, degeneracy, assignment problems.

MODULE IV: GAME THEORY (17 hrs)

Two persons zero sum games, Pure and mixed strategy with saddle point, Solution of pure strategy games, Solution of mixed strategy problems by arithmetic method, Principle of dominance.

Reference:

1. **Kapoor, V. K. Operations Research**
2. **Swarup, Kanti , Gupta, P. K. & Mohan, Man. Operations Research. Sultan Chand & Sons.**
3. **Mital, K. V. & Mohan, C. Optimization Methods in Operations Research and System Analysis**
4. **Sharma, J .K. Operations Research Theory and Applications. Macmillan.**
5. **Mishra, B.N. & Mishra, B. K. Optimization Linear Programming. Ane Books.**

SYLLABI OF COMPLEMENTARY COURSES IN STATISTICS

COMPLEMENTARY COURSE IN STATISTICS TO BSc. MATHEMATICS PROGRAMME

SEMESTER I – COURSE I
ST1MMMT1 – BASIC STATISTICS

Hours per Week : 4 Number of Credits : 3

Module I : Different aspects of data, and its collection

Statistics - meaning, definition, applications. Concepts of a statistical population and sample. Different types of characteristics and data – qualitative and quantitative, discrete and continuous. Different types of scale – nominal and ordinal, ratio and interval. Collection of data – census and sampling. Different types of random samples – simple random, systematic, stratified and cluster (description only). Primary and secondary data. Schedule and questionnaire. Data collection by different methods - direct, using third parties, sending questionnaire, by mail/telephone. (20 L)

Module II : Presentation of data, Central tendency

Classification and tabulation – one- way and two – way classified data. Preparation of frequency distribution. Relative frequency and cumulative frequency distributions. Stem and leaf chart, line diagram, bar diagram, pie diagram, histogram, frequency polygon, frequency curve and ogives. Averages – arithmetic mean, median, mode, geometric mean, harmonic mean and weighted averages. Quantiles – quartiles, deciles, percentiles. (And problems based on the above topics). (16L)

Module III : Dispersion, Moments, Skewness and Kurtosis

Measures of absolute dispersion – range, quartile deviation, mean deviation and standard deviation. Box plot. Relative measures. C.V. Raw moments, central moments and their inter relation. Combined mean and standard deviation. Skewness – Pearson's, Bowly's and moment measure of skewness. Kurtosis – percentile and moment measure of kurtosis. (And problems based on the above topics). (18L)

Module IV : Probability

Random experiments - complement, union and intersection of events and their meaning. Mutually exclusive, equally likely and independent events. Classical, frequency and axiomatic approaches to probability. Addition theorem (up to 3 events), Conditional probability. Multiplication theorem (up to 3 events). Total probability law. Bayes' theorem. (And problem based on the above topics). (18L)

References

1. Miller, I and Miller, M (2014), Mathematical statistics, 8th Edition, Pearson Education Inc.
2. .Gupta, SC and Kapoor, VK (2002), Fundamentals of Mathematical Statistics, 11th Edition, Sultan Chand and Sons.
3. Gupta, SC and Kapoor, VK (2007), Fundamentals of applied Statistics, Sultan Chand and Sons.
4. Medhi J (2006). Statistical Methods, 2nd Edition, New Age International Publishes
5. Goon, AM. Gupta MK and Dasgupta, B (1986), Fundamentals of statistics, volume1, World press, Kolkata.
6. Mood AM, Graybill, F.A and Bose, F.A. (1974). Introduction to Theory of Statistics, Oxford and IBH Publishers.
7. Mukhopadhya, P (1999). Applied Statistics, New Central Book Agency Private Limited, Kolkatta.

COMPLEMENTARY COURSE IN STATISTICS TO BSc. MATHEMATICS PROGRAMME

SEMESTER II – COURSE II

ST2MMMT2 –PROBABILITY DISTRIBUTION OF RANDOM VARIABLES

Hours per Week : 4 Number of Credits : 3

Module I : Probability Distribution of Univariate Random Variables

Concept of random variables. Discrete and continuous random variables. Probability mass and density functions and cumulative distribution functions. Evaluation of conditional and unconditional probabilities. Relation of p.m.f. / p.d.f. with relative frequency and c.d.f. with less than cumulative frequency distribution. Change of variables – methods of jacobian and cumulative distribution function (one variable case). Probability integral transformation. (And problems based on the above topics) (17 L)

Module II : Probability Distribution of Bivariate Random Variables

Concept of a two component random vector. Bivariate probability mass and density functions. Marginal and conditional distributions. Independence of bivariate random variables. (And problems based on the above topics) (15 L)

Module III : Index Numbers, Time Series

Definition of index numbers. Price Index Numbers. Price Index Numbers as simple (A.M, G.M) and weighted averages(AM) of price relatives. Laspeyer’s, Paasche’s , Marshal-Edgeworth and Fisher’s Index Numbers. Time - Reversal and Factor – Reversal Tests. Cost of living index numbers - family budget and aggregate expenditure methods. An introduction to wholesale price index and consumer price index.

Components of time series. Estimation of trend by semi- average and moving average methods. (And problems based on the above topics) (20 L)

Module IV : Correlation and Regression

Bivariate data. Types of correlation. Scatter diagram - fitting of polynomial equations of degree one and two, exponential curve, power curve. Karl Pearson’s product moment and Spearman’s rank correlation coefficients. Computation of correlation coefficient from two – way tables. Coefficient of determination. Regression equations , identification and Estimation (And problems based on the above topics) (20 L)

References

1. Gupta SC and Kapoor VK (2002), Fundamentals of Mathematical Statistics, 11th Edition, Sultan Chand and Sons.
2. Hogg RV, Mckean J.W and Craig A.T. (2014) Introduction to Mathematical Statistics, 6th Edition, Pearson Education Inc.
3. Medhi J (2006), Statistical Methods, 2nd Edition, New Age International Publishes.
4. Miller, I. and Miller, M (2014), Mathematical Statistics, 8th Edition, Pearson Education Inc.
5. Mood, AM Graybill, FA and Bose, FA (1974), Introduction to Theory of Statistics, Oxford and IBH Publishers.
6. Ross S. (2003), A First Comes in probability Pearson, Education Publishers, Delhi

COMPLEMENTARY COURSE IN STATISTICS TO BSc. MATHEMATICS PROGRAMME

SEMESTER III – COURSE III

ST3MMMT3 – STANDARD PROBABILITY DISTRIBUTIONS

Hours per Week: 5 Number of Credits: 4

Module I: Mathematical Expectation

Expectation of random variables and their functions. Definition of raw moments, central moments and their interrelation, AM, GM, HM, SD, MD, covariance, Pearson's correlation coefficient in terms of expectation. MGF and characteristics function and simple properties. Moments from MGF. Statement of uniqueness theorem. Conditional mean and variance. (And problems based on these topics) (25 L)

Module II: Standard Probability Distributions

Uniform (discrete and continuous), Bernoulli, binomial, Poisson, Geometric, Exponential, Gamma – one and two parameters, Beta (Type I and Type II) mean, variance, MGF, additive property, lack of memory property. Normal distribution with all properties. Fitting of Binomial, Poisson and Normal distributions. (And problems based on these topics) (20 L)

Module III: Law of Large Numbers and Central Limit Theorem

Chebychev's inequality, Weak Law of Large Numbers – Bernoulis and Chebychev's form. Central Limit Theorem (Lindberg- Levy form with proof) (And problems based on these topics.) (20 L)

Module IV: Sampling Distributions

Concept of sampling distributions. Statistic (s) and standard error (s). Mean and variance of sample mean when sampling is from a finite population. Sampling distribution of mean and variance from Normal distribution. Chi-square, t, F distributions and statistics following these distributions. Relation among Normal, Chi-square, t and F distributions. (And problems based on these topics) (25 L)

References

1. Gupta SC and Kapoor VK (2002), Fundamentals of Mathematical Statistics, 11^{th} Edition, Sultan Chand and Sons.
2. Hogg RV, Mckean J.W and Craig A.T. (2014) Introduction to Mathematical Statistics, 6^{th} Edition, Pearson Education Inc.
3. Medhi J (2006), Statistical Methods, 2^{nd} Edition, New Age International Publishes.
4. Miller, I. and Miller, M (2014), Mathematical Statistics, 8^{th} Edition, Pearson Education Inc.
5. Mood, AM Graybill, FA and Bose, FA (1974), Introduction to Theory of Statistics, Oxford and IBH Publishers.
6. Ross S. (2003), A First Comes in probability Pearson, Education Publishers, Delhi

COMPLEMENTARY COURSE IN STATISTICS TO B Sc. MATHEMATICS PROGRAMME

SEMESTER IV – COURSE IV

ST4MMMT4 – STATISTICAL INFERENCE

Hours per Week : 5 Number of Credits : 4

Module I: Point Estimation

Concepts of Estimation, Estimators and Estimates. Point and Interval estimation. Properties of good estimators – unbiasedness, efficiency, consistency and sufficiency. Factorization theorem (statement) (And problems based on these topics) (25 L)

Module II: Methods of Estimation, Interval Estimation

Methods of moments, maximum likelihood, Invariance property of ML Estimators (without proof) minimum variance. Cramer – Rao inequality (without proof). 100 (1-α)% confidence intervals for mean, variance, proportion, ratio of variances, difference of means and proportions (And problems based on these topics) (20L)

Module III: Testing of Hypotheses, Large Sample Tests

Statistical hypotheses, null and alternate hypotheses, simple and composite hypotheses, type I and Type II errors, Critical region, Size and power of a test, p- value, Neyman – Pearson approach. Large sample tests – Z tests for means, difference of means, proportion and difference of proportion, chi- square tests for independence, homogeneity and goodness of fit. (And problems based on these topics) (25 L)

Module IV: Small Sample Tests

Normal test for mean, difference of means, proportion and difference of proportions (when σ known) t- test for mean and difference of means (when σ unknown), t- test for r=0, paired t- test, chi square test, F- test for ratio of variances. One-way ANOVA for testing the equality of more than two means (derivation not required) (And problems based on these topics) (20 L)

References

1. Gupta SC and Kapoor VK (2002), Fundamentals of Mathematical Statistics, 11th Edition, Sultan Chand and Sons.
2. Hogg RV, Mckean J.W and Craig A.T. (2014) Introduction to Mathematical Statistics, 6th Edition, Pearson Education Inc.
3. Medhi J (2006), Statistical Methods, 2nd Edition, New Age International Publishes.
4. Miller, I. and Miller, M (2014), Mathematical Statistics, 8th Edition, Pearson Education Inc.
5. Mood, AM Graybill, FA and Bose, FA (1974), Introduction to Theory of Statistics, Oxford and IBH Publishers.
6. Ross S. (2003), A First Comes in probability Pearson, Education Publishers, Delhi.

COMPLEMENTARY COURSE IN STATISTICS TO BCA PROGRAMME
SEMESTER I – COURSE I
ST1CAMT1 - BASIC STATISTICS

Hours per Week : 4 Number of Credits : 4

Module I: Different aspects of data, and its collection

Statistics –meaning, definition, applications. Concepts of a statistical population and sample. Different types of characteristics and data – qualitative and quantitative, discrete and continuous, Different types of scale – nominal and ordinal, ratio and interval. Collection of data – census and sampling. Different types of random samples – simple random sample, systematic, stratified and cluster (description only). Primary and secondary data. Schedule and questionnaire. Data collection by different methods- direct, using third parties, sending questionnaire, by mail/telephone. (20 L)

Module II : Presentation of data, Central tendency

Classification and tabulation – one way and two – way classified data. Preparation of frequency distribution. Relative frequency and cumulative frequency distributions. Stem and leaf chart, line diagram, bar diagram, pie diagram, histogram, frequency polygon, frequency curve and ogives. Averages – arithmetic mean, median, Mode, geometric mean, harmonic mean and weighted averages. Quantiles – quartiles, deciles, percentiles. (And problems based on the above topics). (16L)

Module III : Dispersion, Moments, Skewness and Kurtosis

Measures of absolute dispersion – range, quartile deviation, mean deviation and standard deviation. Box plot. Relative measures. C.V. Raw moments, central moments and their inter relation. Combined mean and standard deviation. Skewness – Pearson's, Bowly's and moment measure of skewness. Kurtosis – percentile and moment measure of kurtosis. (And problems based on the above topics). (18L)

Module IV : Probability

Random experiments. complement, union and intersection of events and their meaning. Mutually exclusive, equally likely and independent events. Classical, frequency and axiomatic approaches to probability. Addition theorem (up to 3 events),). Conditional probability. Multiplication theorem (up to 3 events).Total probability law. Bayes' theorem. (And problems based on the above topics). (18 L)

References

1. Miller, I and Miller, M (2014), Mathematical statistics, 8th Edition, Pearson Education Inc.
2. Medhi J (2006). Statistical Methods, 2nd Edition, New Age International Publishes.
3. Gupta, SC and Kapoor, VK (2002), Fundamentals of Mathematical Statistics, 11th Edition, Sultan Chand and Sons.
4. Gupta, SC and Kapoor, VK (2007), Fundamentals of applied Statistics, Sultan Chand and Sons.
5. Goon, AM. Gupta MK and Dasgupta, B (1986), Fundamentals of statistics, volume1, World press, Kolkata.
6. Mood AM, Graybill, F.A and Bose, F.A. (1974). Introduction to Theory of Statistics, Oxford and IBH Publishers.
7. Mukhopadhya, P (1999). Applied Statistics, New Central Book Agency Private Limited, Kolkatta.

COMPLEMENTARY COURSE IN STATISTICS TO BCA PROGRAMME
SEMESTER III – COURSE II
ST3CAMT2 - ADVANCED STATISTICAL METHODS

Hours per Week : 4 Number of Credits : 4

Module I : **Probability Distribution of Random Variables**
Random variables, probability density(mass) function, distribution function. Expectation of random variables and their functions, mean, standard deviation and moment generating function.(And simple problems based on the above topics). (18 L)

Module II : Standard Probability Distributions
Theoretical distributions. Discrete distributions -binomial and Poisson , mean, variance, moment generating function and fitting. Continuous distributions- normal distribution only. Area under the normal curve, Central limit theorem (without proof) (And simple problems based on the above topics). (20 L)

Module III : Correlation and Regression
Bivariate data. Types of correlation. Scatter diagram. Karl Pearson's product moment and Spearman's rank correlation coefficients. Regression equations – –Identification, Estimation. (And simple problems based on the above topics). (18 L)

Module IV : Statistical Estimation
Concept of Estimation. Types of Estimation - Point and Interval, Properties of good estimators-Unbiasedness, Efficiency; Consistency; Sufficiency; Interval Estimation, Interval Estimation for Mean, Variance and Proportion. (And simple problems based on the above topics). (16L)

References

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.
4. Robert V. Hogg, Elliot A. Tanis and Jagan Mohan Rao, Probability and Statistical Inference, Pearson Publishers
5. Robert V. Hogg, Joseph Mckean and Allen T. Craig, Introduction to Mathematical Statistics Pearson Publishers
6. Irwin Miller and Marylees Miller, Pearson Publishers Mathematical Statistics with Applications,
7. J. Medhi, Statistical Methods New Age International.

MODEL QUESTION PAPERS

B Sc DEGREE (CBCS) EXAMINATION
First Semester
Core Course -- MM1CRT01- LOGIC AND DIFFERENTIAL CALCULUS

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Let P be the statement "I like popcorn", Q be the statement "I like ice cream". Write an English sentence for ¬ (P^Q).
2. Define Tautology.
3. Find $\frac{dy}{dx}$ if $2y = x^2 + \sin y$.
4. Find the absolute extreme values of $g(t) = 8t - t^4$ on [-2, 1].
5. State the first derivative theorem for local extreme values.
6. Find $\frac{d^n}{dx^n}$ (sin(5x + 3))
7. If x = t – sin t, y = 1 – cos t, value of $\frac{d^2y}{dx^2}$ at $(\frac{\pi}{2}, 2)$ will be
8. State Maclaurin's theorem.
9. Define center of curvature.
10. Define an envelope.

(10×1=10 marks)

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Prove that[¬P ∧ (P ∨ Q)] → Q is a tautology using logical equivalence.
12. Show that $(y \cdot \bar{x}) + (y \cdot x) = y$ for any elements x and y in a Boolean algebra.
13. Show that $[(P \to Q) \wedge (Q \to P)] \Leftrightarrow [P \leftrightarrow Q]$.
14. Show that $y = |x|$ is not differentiable at the origin.
15. If f has a derivative at x = c, then prove that f is continuous at x = c.
16. Find an equation for the tangents to the curve $y = x + \frac{2}{x}$.
17. If y = a cos (log x) + b sin (log x) show that $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 0$.
18. Find $(x^2e^x\cos x)_n$.
19. Evaluate $\lim_{x\to 0} \cos x^{\cot x}$.
20. Expand $\log(x + a)$ in powers of x by Taylor's series.
21. Find the envelope of family at all straight lines y = mx + $\frac{a}{m}$.
22. Prove that radius of curvature at any point of the catenary y = c cosh $\frac{x}{c}$ varies as the square of the ordinate.

(8×2=16 marks)

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. If n is a positive composite number, then n has at least one prime factor p with $1 \le p \le \sqrt{n}$.
24. Prove that $\sqrt{2}$ is irrational.
25. Show that $\lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1$ (θ in radians).
26. Find the tangent and normal to the curve $x^2 - xy + y^2 = 7$ at the point (-1, 2).
27. Find the n^{th} derivative of $y = \frac{x}{x^2 + a^2}$.
28. Find the values of a and b in order that $\lim_{x \to 0} \frac{x\,(1 + a\cos x - b\sin x)}{x^3}$ may be equal to 1.
29. Find the center of curvature of four hypocycloid $x = a\cos^3\theta$, $y = a\sin^3\theta$.
30. Show that the curvature of the point $(\frac{3a}{2}, \frac{3a}{2})$ on the Folium $x^3 + y^3 = 3axy$ is $\frac{-8\sqrt{2}}{3a}$.
31. Find the envelope of $x^2 \sin\alpha + y^2 \cos\alpha = a^2$, where α is a parameter.

(6×4=24 marks)

Section D

*Answer any **two** questions*

*Each question carries**15**marks*

32. (a) Let x and y be elements of a Boolean algebra. Then prove that x . y = x if and only if $x . \bar{y} = 0$.
    (b) Let x and y be elements of a Boolean algebra. Then prove that x = y if and only if x Δ y = 0
33. State and prove mean value theorem.
34. (a) If $y = \cos(m\sin^{-1} x)$ show that $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} + (m^2 - n^2)y_n = 0$ and hence find $y_n(0)$.
    (b) Determine $\lim \left(\frac{\pi}{2} - x\right)^{\tan x}$ as $x \to (\frac{\pi}{2} - 0)$.

35. (a) Show that the evolute of the ellipse $x = a\cos\theta$, $y = b\sin\theta$ is $(ax)^{\frac{2}{3}} + by^{\frac{2}{3}} = (a^2 - b^2)^{\frac{2}{3}}$.

(b) Find the asymptotes of $x^3 - x^2y - xy^2 + y^3 + 2x^2 - 4y^2 + 2xy + x + y + 1 = 0$.

(2×15=30 marks)

B Sc DEGREE (CBCS) EXAMINATION
Second Semester
Core Course-MM2CRT02- ANALYTIC GEOMETRY, TRIGONOMETRY AND MATRICES

Time: Three Hours **Maximum : 80 Marks**

Section A
*Answer **all** the questions*
*Each question carries **1** mark*

1. Define an ellipse.
2. Identify the graph of the equation $xy - y^2 - 5y + 1 = 0$.
3. Write a parametrization of the circle $x^2 + y^2 = a^2$.
4. Find the Cartesian coordinate of the point $(\sqrt{2}, \frac{\pi}{4})$.
5. Write the series expansion of cos x in terms of x.
6. What is the period of hyperbolic sine.
7. What is $x^n - \frac{1}{x^n}, if\ x = \cos\alpha + i\sin\alpha$.
8. Define rank of a matrix.
9. Give an example of a skew symmetric matrix.
10. State true or false: A homogeneous system of equations is not always consistent.

$(10 \times 1 = 10)$

Section B
*Answer any **eight** questions*
*Each question carries**2** marks*

11. Find the hyperbola's standard form equation from the given information.
Foci : $(0, \pm\sqrt{2})$, Asymptotes : $y = \pm x$.
12. The coordinate axes are to be rotated through an angle θ to produce an equation for the curve $2x^2 + \sqrt{3xy} + y^2 - 10 = 0$ that has no cross product term. Find θ.
13. Find an equation for the line tangent to the curve at the point defined by the given value of t where x = 2 cos t, y = 2 sin t, $t = \frac{\pi}{4}$.
14. Find the Cartesian equation for the line $r\cos(\theta - \frac{\pi}{3}) = 2$.
15. Graph the set of points whose polar coordinates satisfy the equation $\theta = \frac{\pi}{3}$, $-1 \le r \le 3$.
16. Prove that $\cosh 2x = \cosh^2 x + \sinh^2 x$
17. If $x + iy = \cosh(u + iv), Prove\ that\ \frac{x^2}{cosh^2 u} + \frac{y^2}{sinh^2 u} = 1$.
18. If $\tan(\alpha + i\beta) = \sin(x + iy)$. Show that $\coth y \sinh 2\beta = \cot x \sin 2\alpha$.
19. Give the elementary transformations of a matrix.

20. Show that the matrices $\begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$ and $\begin{bmatrix} 4 & 3 & 3 \\ -1 & 0 & -1 \\ -4 & -4 & -3 \end{bmatrix}$ are involutary.
21. Using matrix method, solve the system of equations $x_1 + 3x_2 = 1,\ 2x_1 + 5x_2 = 3$.
22. If A is non-singular, prove that the rank of AB is same as that of B.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Find a Cartesian equation for the hyperbola centered at the origin that has a focus at (3, 0) and the line x = 1 as the corresponding directrix.
24. Fine the center, foci and vertices of the conic $x^2 – y^2 – 2x – 4y = 4$.
25. Find the length of the curve $x = \cos^3 t$, $y = \sin^3 t$, $0 \leq t \leq 2\pi$.
26. Graph the curve $r^2 = 4 \cos \theta$.
27. Sketch the graph and label the vertices with appropriate polar coordinates of $r = \frac{25}{10-5\cos\theta}$.
28. If n is even, prove that

$$2^{\frac{n-1}{2}} \sin\frac{2\pi}{2n} \sin\frac{4\pi}{2n} \sin\frac{6\pi}{2n} \ldots \sin\frac{(n-2)\pi}{2n} = \sqrt{n}$$

29. If x is real, show that (i) $sinh^{-1}x = \log(x + \sqrt{x^2+1})$ and
(ii) $cosh^{-1}x = \log(x + \sqrt{x^2-1})$
30. State Cayley Hamilton Theorem and verify it for the matrix $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.
31. Reduce to the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 1 \\ 4 & 3 & 1 \end{bmatrix}$ to its normal form.

$(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries**15**marks*

32.

(a) A wheel of radius a rolls along b horizontal straight line. Find parametric equation for the path traced by b point P on the wheel's circumference.

(b) The hyperbola $\frac{y^2}{4} - \frac{x^2}{5} = 1$ is shifted 2 units down to generate the hyperbola $\frac{(y+2)^2}{4} - \frac{x^2}{5} = 1$. Find the center, foci vertices and asymptotes of the new hyperbola.

33.

(a) Find the points of intersection of the curves $r^2 = 4 \cos \theta$ and $r = 1 – \cos\theta$.

(b) Graph the conic $r = \frac{1}{1-\sin\theta}$.

(c) Find a polar equation for the conic if e = $\frac{1}{2}$ and x = 1.

34. Sum the series:

(i) $\cosh\alpha - \frac{1}{2}\cosh 2\alpha + \frac{1}{3}\cosh 3\alpha - \cdots \quad to\ \infty$

(ii) $\sinh\alpha - \frac{1}{2}\sinh 2\alpha + \frac{1}{3}\sinh 3\alpha - \cdots \quad to\ \infty$

(iii) $x\sinh\alpha + x^2\sinh 2\alpha + x^3\sinh 3\alpha + \cdots \quad to\ \infty$

35. Determine the eigenvalues and associated eigenvectors of the matrix A=$\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$. $(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
THIRD SEMESTER
Core Course-MM3CRT03 : INTEGRAL CALCULUS, PARTIAL DIFFERENTIATION AND NUMBER THEORY
For B Sc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. Write the formula for finding the volume of a solid of integrable cross sectional area $A(x)$ from $x = a$ to $x = b$
2. What is the length of the curve $x = g(y), c \leq y \leq d$
3. What is the volume of a closed bounded region D in space.
4. Write the formula for finding the area of a closed and bounded region R in the polar coordinate plane.
5. Write the average value of an integrable function f over a bounded region R in the plane.
6. State mixed derivative theorem.
7. Define critical point of a function $f(x, y)$.
8. Sate the fundamental theorem of arithmetic.
9. Prove that $a \equiv a(mod\ n)$ where $n > 1$
10. Find $\tau(12)$and $\sigma(12)$.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

11. The region between the curve $y = \sqrt{x}, 0 \leq x \leq 4$ and the x −axis is revolved about then x −axis to generate a solid. Find its volume.
12. Find the volume of the solid generated by revolving the region enclosed by the triangle with vertices $(1, 0), (2, 1)$ and $(1, 1)$ about the y-axis
13. Find the area of the surface generated by revolving the curve $y = 2\sqrt{x}\ 1 \leq x \leq 2$ about the x-axis.
14. Find the area of the region R enclosed by the parabola $y = x^2$ and the line $y = x + 2$.
15. Evaluate $\int_{-1}^{0} \int_{-1}^{1} (x + y + 1)dxdy$
16. Calculate $\iint_R \frac{\sin x}{x} dA$ where R is the triangle in the xy plane bounded by the x-axis , the line $y = x$ an the line $x = 1$.
17. Use chain rule to find $\frac{dw}{dt}$if $w = xy + z, x = \cos t, y = \sin t, z = t$.
18. State the second derivative test for local extreme values.

19. Find the local extreme values of $f(x, y) = x^2 + y^2 - 4y + 9$.
20. If p is a prime an p/ab prove that then p/aor p/b.
21. Prove that $\sqrt{2}$ is irrational.
22. If p is a prime and $k > 0$, prove that $\varphi(p^k) = p^k - p^{k-1}$.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Find the length of the curve $y = \left(\frac{x}{2}\right)^{\frac{2}{3}}$ from $x = 0$ to $x = 2$.
24. Using shell method find the volume of the solid obtained by revolving the region bounded by the curve $y = \sqrt{x}$, the x-axis and the line $x = 4$ about the x-axis.
25. Evaluate the integral $\int_0^1 \int_0^{\sqrt{1-x^2}} (x^2 + y^2)\, dxdy$.
26. Evaluate $\int_0^1 \int_0^{\sqrt{z}} \int_0^{2\pi} (r^2 cos^2\theta + z^2) rd\theta drdz$.
27. Evaluate $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ at the point $(u, v) = (2, \frac{\pi}{4})$ using chain rule if $z = 4e^x \ln y$, $x = \ln(u \cos v)$, $y = u \sin v$.
28. Find all second order partial derivatives of the function $f(x, y) = x + y + xy$.
29. Find the local maxima , local minima and saddle points of the function $f(x,\ y) = x^2 + xy + y^2 + 3x - 3y + 4$.
30. For $n > 2$ prove that $\varphi(n)$ is an even integer.
31. State and prove Wilson's theorem.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries**15**marks*

32.
    (c) 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 $x = 3$.
    (d) The region in the first quadrant bounded on the left by the circle $x^2 + y^2 = 3$ on the right by the line $x = \sqrt{3}$ and above by the line $y = \sqrt{3}$ is revolved about the y-axis. Find the volume of the solid generated.
33. Evaluate $\int_0^3 \int_0^4 \int_{x=\frac{y}{2}}^{x=(y/2)+1} \left(\frac{2x-y}{2} + \frac{z}{3}\right) dx\, dy\, dz$ by applying the transformation $u = \frac{(2x-y)}{2}, v = \frac{y}{2}, w = \frac{z}{3}$.
34.
    (a) A delivery company accepts only rectangular boxes the sum of whose length and girth does not exceed 108 in. Find the dimensions of an acceptable box of largest volume.

(b)The plane $x + y + z = 1$ cuts the cylinder $x^2 + y^2 = 1$ in an ellipse. Find the points on the ellipse that lie closest to and farthest from the origin.

36. State and prove Euler's theorem.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Fourth Semester
Core Course - MM4CRT04 : VECTOR CALCULUS, THEORY OF EQUATIONS AND LAPLACE TRANSFORMS
For B Sc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. Check the vector valued function $\overline{r}(t) = \cos t\,\hat{\imath} + \sin t\,\hat{\jmath} + \lfloor t \rfloor \hat{k}$ for continuity.
2. Find the parametric equation of the line which passes through the points $P(-3, 2, -3)$ and $Q(1, -1, 4)$.
3. Define the angle between two intersecting planes.
4. State fundamental theorem of line integrals
5. Write closed loop property of conservative fields.
6. Divide $x^4 - x^2 + 5x - 6$ by $x + 2$ using synthetic division.
7. State factor theorem.
8. If the sum of two roots of the cubic $x^3 + a_1x^2 + a_2x + a_3 = 0$ is zero prove that $a_1a_2 = a_3$.
9. Find Laplace transform of e^{at}
10. What is $L(\frac{f(t)}{t})$.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries **2** marks*

11. Find the angle between the planes $3x - 6y - 2z = 15$ and $2x + y - 2z = 5$.
12. In what direction is the derivative of $f(x, y) = xy + y^2$ at $P(3, 2)$ equal to zero.
13. If $\overline{r}$ is a differentiable vector function of t, of constant length, prove that $\overline{r}.\frac{d\overline{r}}{dt} = 0$
14. Check whether $\overline{F} = (y + y^2 + z^2)\hat{\imath} + (x + z + 2xy)\hat{\jmath} + (y + 2xz)\hat{k}$ is conservative
15. Find $curl(grad\ f)$
16. Find the divergence of $\overline{F} = (x^2 - z)\hat{\imath} + xe^z\hat{\jmath} + xy\hat{k}$.
17. What is the relation between a and b if $x^3 + 2x^2 + 2ax + b = 0$ is exactly divisible by $x + 2$?
18. Write the equation of lowest degree with real coefficients having 2 and $1 - 3i$ as two of its roots.
19. Find the HCF of $x^4 - 6x^2 - 8x - 3$ and $x^3 - 3x - 2$.
20. If $f(t) = sin^2t$, find $L(f(t))$.

21. Let $L(f) = \frac{1}{s(s^2+\omega^2)}$, find $f(t)$
22. Find the inverse transform of $\frac{s}{(s^2-9)^2}$

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Show that if $\overline{u}, \overline{v}$ and $\overline{w}$ are differentiable vector functions of t, then $\frac{d}{dt}(\overline{u}.\overline{v} \times \overline{w}) = \frac{d\overline{u}}{dt}.\overline{v} \times \overline{w} + \overline{u}.\frac{d\overline{v}}{dt} \times \overline{w} + \overline{u}.\overline{v} \times \frac{d\overline{w}}{dt}$.
24. Find the length of the curve $\overline{r}(t) = (\sqrt{2}t)\hat{\imath} + (\sqrt{2}t)\hat{\jmath} + (1-t^2)\hat{k}$ from $(0,0,1)$ to $(\sqrt{2},\sqrt{2},0)$
25. Find the scalar potential function of $\overline{F} = y \sin z\,\hat{\imath} + x \sin z\,\hat{\jmath} + xy \cos z\,\hat{k}$
26. Find the flux of $\overline{F} = yz\hat{\jmath} + z^2\hat{k}$ outward through the surface S cut from the cylinder $y^2 + z^2 = 1, z \geq 0$ by the planes $x = 0$ and $x = 1$.
27. The roots of the equation $x^3 - 3x^2 + kx + 3 = 0$ are in A.P. Find the value of k and solve the equation.
28. If α, β, γ be the roots of the equation $x^3 + px + q = 0$, find $\sum \alpha^2$ and $\sum \alpha^2 \beta$
29. Find the number and position of real roots of $x^3 + x^2 - 2x - 1 = 0$.
30. State and prove first shifting theorem.
31. Solve the integral equation $y(t) = t + \int_0^t y(\tau)\sin(t-\tau)\,d\tau$

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries **15** marks*

32.

(a) Find unit normal vector $\overline{N}$ and curvature κ for the vector $\overline{r}(t) = (\cos t + t\,\sin t)\hat{\imath} + (\sin t - t\cos t)\hat{\jmath} + 3\hat{k}$

(b) Without finding $\boldsymbol{T}$ **and** $\boldsymbol{N}$ write $\boldsymbol{a}$ in the form $\boldsymbol{a} = a_T\boldsymbol{T} + a_N\boldsymbol{N}$ acceleration of the motion $\overline{r}(t) = e^t\cos t\,\hat{\imath} + e^t\sin t\,\hat{\jmath} + \sqrt{2}e^t\hat{k}$.

33.

(a) Use Greens theorem to find the outward flux for the field $\overline{F} = (x + e^y \sin y)\hat{\imath} + (x + e^x \cos y)\hat{\jmath}$ over the curve C: the right hand loop of the lemniscate $r^2 = \cos 2\theta$.

(b) Integrate $g(x,y,z) = xyz$ over the rectangular solid cut from the first octant by the planes $x = a, y = b, z = c$.

34.

(a) Solve $x^3 - 15x - 126 = 0$ using Cardan's method.

(b) If α, β, γ are the roots of the equation of $x^3 + px - q = 0$ find the equation whose roots are $\alpha^2 + \beta^2, \beta^2 + \gamma^2, \gamma^2 + \alpha^2$.

37.

(a) Solve $y'' - 4y' + 3y = 6t - 8$, where $y(0) = 0, y'(0) = 0$.

(b) State and prove convolution theorem.

$2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Fifth Semester
Core Course-MM5CRT05: REAL ANALYSIS - I
For BSc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. State completeness property of ℝ.
2. Define supremum of a bounded set.
3. Write the order properties of ℝ.
4. Give an example of a bounded sequence which is not a Cauchy sequence.
5. Write an unbounded sequence that has a convergent subsequence.
6. Show that $(-1)^n$, n ϵN is not a Cauchy sequence.
7. Is the sequence (n sin n) properly divergent..
8. State Bolzano-Weierstrass Theorem for sequence.
9. What is a Cauchy sequence.
10. Write monotone convergence theorem.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

11. State and prove triangle inequality.
12. Prove that the set ℕ×ℕ is denumerable.
13. Show that if the series $\sum x_n$ converges, then $\lim x_n = 0$.
14. Show that the convergence of a series is not affected by changing a finite number of its terms.
15. Distinguish between absolute convergence and conditional convergence..
16. Prove that if a series is absolutely convergent, then it is convergent.
17. If S_n is the n^{th} partial sum of the alternating series $\sum(-1)^{n+1} z_n$ and if S denotes the sum of the series, show that $|s - s_n| \leq z_{n+1}$
18. Prove or disprove $\mathrm{int}(A \cup B) \subseteq int(A) \cup int(B)$.
19. If the partial sum of $\sum a_n$ are bounded, show that the series $\sum a_n e^{-nt}$ converges for t>0.
20. Discuss the convergence of the sequence $(n^2 a_n)$ where 0<a<1, b>1.
21. Show that if $z_n = (a^n + b^n)^{\frac{1}{n}}, 0 < a < b,$ then $\lim z_n = b$.

22. If $x_n \geq 0, \forall\, n$, and $\lim(-1)^n x_n$ exists, show that (x_n) converges.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. State and prove Cantor's theorem.
24. Use mathematical induction to prove that if a $\epsilon\mathbb{R}$ and $m, n\ \epsilon\mathbb{N}$, $a^{m+n} = a^m a^n$
25. If a,b$\epsilon\mathbb{R}$, then prove that,
    (i) $|a| - |b \leq |a - b|$
    (ii) $|a - b| \leq |a| + |b|$
26. Let $x_1 = 1,\ x_{n+1} = \sqrt{2 +\ x_n}$ for $n\ \epsilon\mathbb{N}$.show that (x_n) converges and find the limit.
27. Prove that a convergent sequence of real numbers is bounded.
28. Show that the series $\sum_{n=1}^{\infty} \frac{1}{\sqrt{n+1}}$ is divergent.
29. Show that the p-series, $\sum \frac{1}{n^p}$ converges, when p>1.
30. If a and b are positive numbers, then prove that $\sum(an + b)^{-p}$converges if p>1 and diverges if p$\leq$ 1.
31. If $z = (z_n)$ be a decreasing sequence of sequence of strictly positive numbers with $lim(z_n) = 0$.Then prove that the alternating series $\sum(-1)^{n-1} z_n$is convergent.

$(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries**15**marks.*

32. (a) If A_m is a countable set for each m ϵN, prove that the union $A = \bigcup_{m=1}^{\infty} A_m$ is countable.
    (b) Prove that the following are equivalent.
    (i) S is a countable set.
    (ii) There exists a surjection of $\mathbb{N}$ onto S.
    (iii)There exists a injection of S into $\mathbb{N}$.
    (c) Prove that the set Q of all rational numbers is denumerable.

33. (a) Let f: A→ R and let C be a cluster point of A. Then prove the following statements are equivalent.
    (i) $\lim_{x \to c} f = L$
    (ii) For every sequence (x_n) in A that converges to c such that $x_n \neq c$ for all n $\epsilon\ N$, the sequence $(f(x_n))$ converges to L.
    (b) If p is a polynomial function on R, prove that $\lim_{x \to c} p(x) = p(c)$

34. (a) Prove that a sequence of real numbers is convergent if and only if it is a Cauchy sequence.

    (b) Establish the convergence or divergence of the sequence (y_n) where

    $y_n=\frac{1}{n+1}+\frac{1}{n+2}+\cdots+\frac{1}{2n}, \quad n\epsilon$ N

35. (a) If X= (x_n) is a decreasing sequence with limx_n=0 and if the partial sums (s_n) of $\sum y_n$ are bounded, then prove that the series $\sum x_n y_n$ is convergent.

    (b) Examine the convergence or the divergence of the series whose n^{th} term is $\frac{n!}{n^n}$

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

Core Course-MM5CRT06: DIFFERENTIAL EQUATIONS

Time: Three Hours **Maximum: 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

$(10 \times 1 = 10)$

1. Give an example of a seperable differential equation.
2. Examine whether the differential equation $(3y + 4xy^2)dx + (2x + 3x^2y)dy$=0 is exact or not.
3. Write the associated polynomial equation of the differential equation $2y'' + 6y' + 2y = 0$.
4. Write Euler's equi-dimensional equation.
5. Determine whether $y = x^2$ is a solution of $x^2\text{y}'' + \text{xy}' - 4\text{y} = 0$.
6. Find the radius of convergence of $1 + \frac{x}{1!} + \frac{x^2}{2!} + \cdots$.
7. Define a regular singular point.
8. Write the general form of a Pfaffian differential equation in n variables.
9. Eliminate arbitrary constants a and b from the equation $z = (x + a)(y + b)$.
10. What is Lagrange's partial differential equation.

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

$(8 \times 2 = 16)$

11. Solve the differential equation $y' = 2xy$.
12. Solve $y^2dx - x^2dy = 0$.
13. Find an integrating factor for the differential equation $x^2y' + xy = x^3$.
14. Find the family of orthogonal trajectories to the curves $y = cx^2$.
15. Solve $y'' - 5y' + 4y = 0$.
16. Find the differential equation of the general solution A+Be^{2x}.
17. Find the general solution of $y'' - 4y' + 4y = 0$.
18. Find a regular singular point of the differential equation $2x^2y'' + x(2x + 1)y' - y = 0$.
19. Find the indicial equation of $2x^2y'' + x(2x + 1)y' - y = 0$
20. Verify that 0 is an ordinary point of $y'' + xy + y = 0$.
21. If X is a vector such that $X. curl\ X = 0$ and μ is an arbitrary function of x,y,z. Prove that$\mu X. curl\ \mu X = 0$
22. Solve the equation $a^2y^2z^2dx$+$b^2x^2z^2dy + c^2x^2y^2dz = 0$.

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

$(6 \times 4 = 24)$

23. Solve $(x+y)dx - (x-y)dy = 0$.
24. Show that a straight line through the origin intersects all integral curves of a homogeneous equation at the same angle.
25. Find the general solution of $y'' + y = \sin x$.
26. Find the general solution of.$x^2y'' + xy' - y = 0$.
27. Find the general solution of $y^{(4)} - 2y^{(3)} + 2y^{(2)} - 2y' + y = 0$
28. Find the general solution of $y'' + y = 0$ in terms of power series in x.
29. Solve the equation$y' = x - y,\ y(0) = 0$.
30. Eliminate arbitrary function f from $z = xy + f(x^2 + y^2)$.
31. Find the integral surface of the linear partial differential equation $x(y^2+z)p - y(x^2+z)q = (x^2 - y^2)z$.

Section D

*Answer any **two** questions*

*Each question carries **15** marks.*

$(2 \times 15 = 30)$

32. (a) Solve the differential equation $xy'' - y' = 3x^2$ using reduction of order.
    (b) Solve the differential equation $y'' + k^2y$ where k is an unknown real constant.

32.By the method of variation of parameters, solve $y''' - 6y'' + 11y' - 6y = e^x$.

33.Use the method of power series to solve $(1-x^2)y'' - 2xy' + p(p+1)y = 0$. Where p is an arbitrary constant.

34. Solve the equations $\frac{dx}{y+az} = \frac{dy}{z+bx} = \frac{dz}{x+cy}$.

B Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

MM5CRT07 : ABSTRACT ALGEBRA
For B Sc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. Define subgroup of a group.
2. Give an example of a cyclic group.
3. Find the number of elements in the set $A = \{\sigma \in S_4 \ / \ \sigma(3) = 3\}$.
4. Every cycle is a permutation.(True/ False)
5. What is the order of the cycle $(1, 4, 5, 7)$.
6. How many homomorphisms are there from Zonto Z.
7. Define torsion group.
8. What is the center of an abelian group G.
9. Give an example of a commutative ring.
10. Find the product 0f $(16)(3)$in the ring Z_{32}.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

11. Prove that every cyclic group is abelian.
12. Describe Klein 4 group.
13. Find the order of each element in Z_4
14. Show that Z_p has no proper non trivial subgroups p is a prime number.
15. Which of the permutations in S_3 are even permutations.
16. Find all the orbits of the permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 5 & 1 & 3 & 6 & 2 & 4 \end{pmatrix}$
17. Find the index of $< 3 >$ in the group Z_{24}.
18. Compute $Ker \ \varphi$ and $\varphi(25)$ for $\varphi: Z \to Z_7$ such that $\varphi(1) = 4$.
19. Find the order of the element $5+< 4 >$ in the factor group $Z_{12}/< 4 >$.
20. Find all units in the ring Q.
21. Show that the cancellation laws hold in a ring R if and only if R has no divisors of 0.
22. Show that an intersection of ideals of a ring R is again an ideal of R.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*
*Each question carries **4** marks*

23. Prove that every subgroup of a cyclic group is cyclic.
24. Show that if H and K are subfroups of an abelian group G, then $HK = \{hk/\ h \in H\ and\ k \in K\}$ is a subgroup of G.
25. Prove that every permutation σ of a finite set is a product of disjoint cycles.
26. Let H be a subgroup of a cyclic group G. Then prove that the order of H is a divisor of the order of G.
27. Let $G_1, G_2, \cdots\cdots\cdots, G_n$ be groups. For $(a_1, a_2, \cdots\cdots\cdots a_n)$ and $(b_1, b_2, \cdots\cdots\cdots, b_n)$ in $\prod_{i=1}^{n} G_i$, define $(a_1, a_2, \cdots\cdots\cdots a_n)(b_1, b_2, \cdots\cdots\cdots, b_n)$ to be the element $(a_1b_1, a_2b_2, \cdots\cdots\cdots a_nb_n)$. Then prove that $\prod_{i=1}^{n} G_i$ is a group called the direct product of the groups G_i under the given binary operation
28. Let S_n be the symmetric group of n letters. Let $\varphi: S_n \to Z_2$ be defined by
$$\varphi(\sigma) = \begin{cases} 0\ , & if\ \sigma\ is\ an\ even\ permutation \\ 1\ , & if\ \sigma\ is\ an\ odd\ permutation. \end{cases}$$
29. Let H be a normal subgroup of G. Then prove that the cosets of H form a group G/H under the binary operation $(aH)(bH) = (ab)H$
30. In the ring Z_n, prove that the divisors of 0 are precisely those non zero elements rhat are not relatively prime to n.
31. Show that if R is a ring with unity and N is an ideal of R such that $N \neq R$, then R/N is a ring with unity.

. $(6 \times 4 = 24)$

Section D

Answer any ***two*** *questions*

*Each question carries**15**marks*

32.

(a) Let G be a cyclic group generated by a with n elements. Let $b \in G$ and let $b = a^s$. Then prove that b generates a cyclic subgroup H of G containg n/d elements, where d is the gcd (n, s) . Also prove that $< a^s >= < a^r >$ if and only if $gcd\ (s, n) = gcd(t, n)$

(b)Find all subgroups of Z_{12} and draw the subgroup diagrams for the subgroups.

33.

(a)Let H and K are subgroups of a group G. Define $\sim$ on G by $a{\sim}b$ if and only if $a = hbk$ for some $h \in H$ and $k \in K$. Prove that $\sim$ is an equivalence relation on G.

(b)State and prove Cayley's theorem.

34. State and prove fundamental homomorphism theorem for groups.

35.

(a)If p is prime, then prove that Z_p is a field.

(b)If R is a ring with additive identity 0, then for any $a, b \in R$

(i)$0a = a0 = 0$

(ii) $a(-b) = (-a)b = -(ab)$

(iii) $(-a)(-b) = ab$

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Fifth Semester

MM5CRT08: HUMAN RIGHTS AND MATHEMATICS FOR ENVIRONMENTAL STUDIES

For BSc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define pollution.
2. Explain thermal pollution. Mention any two ways in which thermal pollution could be prevented.
3. What is the aim of Forest Conservation Act legislated in India?
4. Mention various measures undertaken by UNO for the protection of Human rights.
5. State any two ways in which rights of religious, linguistic and cultural minorities are protected in India.
6. What do you mean by spherical radius of a circle.
7. Define spherical triangle.
8. Define a celestial sphere.
9. Define a diurnal stars
10. Define North torrid zone.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Analyze the impacts felt in the society due to unscientific disposal of solid wastes.
12. Discuss various criteria of Environmental protection act.
13. How can we reduce soil pollution.
14. What are Human Rights? How UDHR helps in the protection of human rights in the global platform?
15. Briefly explain National Human Rights Commission and its functions.
16. Give two contemporary human right issues.
17. Prove that the points of intersection of two great circles are poles of the greatest circle joining their poles
18. In a spherical triangle ABC , right angled at C, show that $\sin(A+B) = \frac{\cos a + \cos b}{1+\cos a \cos b}$.
19. If $A'B'C'$ is the polar triangle of ABC prove that ABC is the polar triangle of $A'B'C'$.
20. Differentiate between visible and invisible hemispheres.

21. Show that the right ascension α and declination δ of the sun will always be connected by the equation $\tan\delta = \tan\omega \sin\alpha$.
22. Prove that the latitude of a place is equal to the altitude of the celestial pole.

$(8 \times 2 = 16)$

Section C

Answer any ***six*** *questions*

Each question carries ***4*** *marks*

23. In what ways do the solid wastes from Industrial units impact ecological balance. Design suitable control measure to tackle the problem.
24. Write a note on noise pollution.
25. Elaborate on the concept of environmental ethics. Why is it said that protection of environment for the future generations is an obligation and moral responsibility of human beings?
26. Evaluate various measures through which the rights of the weaker sections, especially women, are guarded in the Indian society.
27. State and prove the cosine formula.
28. Derive the relation between spherical and rectangular coordinates.
29. Define circumpolar stars and find the conditions that a star is circumpolar.
30. Find the latitude of a place at which the longest day is twice as long as the shortest day.
31. Trace the changes in the coordinates of the sun in the course of a year

$(6 \times 4 = 24)$

Section D

Answer any ***two*** *questions*

*Each question carries****15****marks*

32. Explain the causes, consequences and control measures for various types of pollution occurring in the environment.
33. Elaborate on any three important legislative measures undertaken by India for preserving nature and controlling Environmental pollution.
34.
    (a) Find a relation between spherical and rectangular coordinates.
    (b)In a spherical riangle ABC if $A = \frac{\pi}{5}$, $B = \frac{\pi}{3}$ and $C = \frac{\pi}{2}$. Show that $a + b + c = \frac{\pi}{2}$.
35.
    (a)Trace the changes in the azimuth of a star in the course of a day.
    (b)Find the duration of perpetual day in a place of latitude $\varphi > 90^o - \omega$.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

Fifth Semester

Open Course - MM5OPT01: FOUNDATIONS OF MATHEMATICS

Time: Three Hours **Maximum: 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. State true or false $\{1,3,5\} \subset \{1,5,3\}$.
2. If $A = \{1,2\}, B = \{a,b,c\}$ find $A \times B$
3. If a set has n elemnets, how many relations are there on the set?
4. Let p be 'He is rich is rich' and q be 'He is unhappy'. Give a verbal simple sentence for $p \wedge \neg q$.
5. Negate the statement "$2 + 3 = 5$".
6. How many permutations on a set of n elements.
7. Find n if $P(n,2) = 72$
8. How many committees of four can be formed from 7 people.
9. If a linear programming problem has a solution, then the solution occurs at …….. of the constraint set.
10. Solve $\frac{2x+1}{x-4} = \frac{3}{5}$.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Define subset of a set.
12. Find the number of elements in the power set $P(S)$ of the set $S = \{\{\varphi\},1,\{2,3\}\}$.
13. List the elements of the sets $A = \{x/\ x \in N, 3 < x < 12\}$ and $B == \{x/\ x \in N, 4 + x = 3\}$
14. Find the truth table for $p \vee \neg q$
15. Determine the truth value $4 + 5 = 9$and $1 + 3 = 4$.
16. Let p be 'It is cold' and let q be ' It is raining'. Write ' It is raining or it is not cold' in symbolic form.
17. Find the value of $n$if ${}^{n}P_{2} = 12$.
18. Simplify $\frac{n!}{(n-2)!}$
19. In how many ways ca a cricket team of 11 be chose out of 14 players.
20. 17% of what number is 68.
21. Given that $1.4 < \sqrt{2} < 1.5$, show that $1 + \sqrt{2} < 2.5$
22. Sketch the solution set of $x + y \leq 8, x - 2y \leq 2, x \geq 0, y \geq 0, y - x \leq 5$.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Let $A = \{a, b, c, d, e\}$, $B = \{a, b, d, f, g\} C = \{b, c, e, y, h\}$, $D = \{d, e, f, g, h\}$. Find $(i) A \cap (B \cup D) (ii) B \setminus (C \cup D)$.
24. Consider the Venn diagram of two arbitrary seta $A$and B. Shade the sets $A \cap B^C$and $(B \setminus A)^C$.
25. Verify whether the proposition $p \vee (p \wedge q)$ is a tautology.
26. Find the truth table for $\neg p \wedge q$
27. Find the number of permutations which can be made with the letters of the word 'ENGINEERING'
28. Six papers are set in an examination, of which two are mathematical. In how many different ways can the papers be arranged so that two mathematical papers are together?
29. Find two real numbers a and b whose product is 100 and whose sum is 30
30. A tank contains 1000 gallons of gasoline. Alcohol is piped in at the rate of 13 gallons per minute. When will the concentration of alcohol in the mixture reach 10%.
31. A treasure hunter found a bar made of gold and silver. The bar weighs 15693gm and has volume 932cc. The density of gold is 18.85gm/cc and that of silver is 10.6gm/cc. What is the volume of each metal does the bar contain.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries**15**marks*

32.

(a)Prove that $(A \cup B)^C = A^C \cap B^C$

(b)Let A and B be any sets. Prove that A is the disjoint uion of $A \setminus B$ and $A \cap B$

33.

(a)Show that $\neg(p \wedge q) \equiv \neg p \vee \neg q$

(b) Verify that the proposition $(p \wedge q) \wedge \neg(p \vee q)$ is a contradiction.

34. Out of 4 officers and 10 clerks in an organization, a committee of five consisting of 2 officers and 3 clerks is to be formed. In how many ways can this be done if
    (a) Any officer and any clerk can be included
    (b) One particular clerk must be included
    (c) One particular officer cannot be included in the committee.

38. A refinery produces gasoline and heating oil with a combined capacity of almost 30, 000 barrels per day. It must produce at least 10,000 barrels of gasoline per day. Also it must produce at least half as much oil as gas, but not more than 15,000 barrels per day. The profit is Rs 1.50 per barrel on oil. How many barrels of each fuel should the refinery produce daily in order to maximize its profit.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

Sixth Semester

Core Course - MM6CRT09: REAL ANALYSIS -II

For BSc Mathematics (Model I)

Time: Three Hours **Maximum: 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Let f be defined for all x$\epsilon\mathbb{R}, x \neq 2$, by f(x)=$\frac{x^2+x-6}{x-2}$. Can f be defined at x=2 in such a way that f is continuous at this point.
2. Let $x \leftrightarrow [x]$, denote the greatest integer function. Determine the point of continuity of the function f(x)=x-[x].
3. When we say that a function f has an absolute maximum on a set A.
4. Define Riemann sum of a function.
5. Define Darboux integral of f over [a,b].
6. Let f(x)=|x| for -1$\leq x \leq 2$. Calculate L(f,P) and U(f,P) for the partition P={-1,0,1,2}
7. If I=[0,4], Calculate the norm of the partition P={0,0.5,2.5,3.5,4}..
8. If A$\subseteq \mathbb{R}$ and$\phi: A \rightarrow \mathbb{R}$ is a function. Define uniform norm of ϕ on A.
9. Write Cauchy's criterian for uniform convergence of series of functions.
10. Evaluate $\lim_{x\to\infty} x \ln(1+\frac{1}{x})$.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries **2** marks*

11. Show that the absolute value function f(x)=|x| is continuous at every point x $\epsilon\mathbb{R}$.
12. State Bolzano's Intermediate value theorem.
13. Prove that every constant function on [a,b] is in R[a,b].
14. Consider the function h defined by h(x)=x+1 for $x\ \epsilon[0,1]$ rational and h(x)=0 for $x\ \epsilon[0,1]$ irrational. Show that h is not Riemann integrable.
15. Let f $\epsilon\ R[a,b]$with$f([a,b]) \subseteq [c,d]$ and let $\phi: [c,d] \rightarrow \mathbb{R}$ be continuous. Then prove that the composition $\phi \circ f$ belongs to $R[a,b]$.
16. If $f: I \rightarrow \mathbb{R}$ has a derivative at c $\epsilon\ I$.Prove that f is continuous at c.
17. Evaluate$\lim_{x\to 0^+} \frac{\ln \sin x}{\ln x}$
18. Use Mean Value theorem to prove that $|\sin x - \sin y| \leq |x-y|$ for all x,y$\epsilon\mathbb{R}$.
19. Show that the sequence $(x^2 e^{-nx})$ converges uniformly on $[0,\infty]$.
20. Let (f_n) be a sequence of functions on a set $A \subseteq \mathbb{R}$ and (f_n) converges uniformly on A to a function f:A→ $\mathbb{R}$. Then show that f is continuous on A.

21. Let (M_n) be a sequence of positive real numbers such that $|f_n(x)| \leq M_n$ for $x \epsilon D$. If the series $\sum M_n$ is convergent, prove that $\sum f_n$ is uniformly convergent.
22. Suppose that f is continuous on [a,b], that $f(x) \geq 0$ for all x ϵ [a, b], and that $\int_a^b f\,dx = 0$. Prove that f(x)=0 for all x ϵ [a, b].

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Show that the function $f(x) = \frac{1}{x}$ is uniformly continuous on the set A=[a,∞), where a is a positive number.
24. Let $I \subseteq \mathbb{R}$ be an interval and let f :I→ ℝ be strictly monotone and continuous on I. Then show that the function g inverse to f is strictly monotone and continuous on J=f(I).
25. If f:[a,b]→ ℝ is continuous on [a,b]. Then show that $f \epsilon R[a, b]$.
26. Prove that if $f(x) = c$ for x ϵ [a, b], then itdDarboux integral is equal to $c(b - a)$.
27. Let $I = [a, b]$ and let $f: I \to \mathbb{R}$ be a bounded function on I. Then prove that f is Darbouxintegrable on I if and only if for each $\epsilon > 0$, there is a partition P of [a,b] such that $U(P, f) - L(P, f) < \epsilon$.
28. If R is the radius of convergence of the power series $\sum a_n x^n$, then show that the series is absolutely convergent if |x|< R and divergent if |x|>R.
29. State and prove Caratheodory's theorem.
30. Let $I \subseteq \mathbb{R}$ be an interval, let c ϵI and let $f: I \to \mathbb{R}, g: I \to \mathbb{R}$ be functions that are differentiable at c. Prove that the function fg is differentiable at c.
31. Let $f: \mathbb{R} \to \mathbb{R}$ be defined by $f(x) = x^2$ for x rational and $f(x) = 0$, elsewhere. Show that f is differentiable at x=0 and find $f'(0)$.

$(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries **15** marks.*

32. (a) State and prove maximum-minimum theorem.
    (b)If f: $A \to \mathbb{R}$ is uniformly continuous on a subset A of ℝ and if (x_n) is a Cauchy sequence in A, then prove that $f(x_n)$ is a Cauchy sequence in ℝ.

33. (a) State and prove Fundamental theorem of Calculus, Fist form.
    (b) If $f: I \to \mathbb{R}$is bounded and P is a partition of L and if Q is a refinement of P, then prove that $L(P, f) \leq L(P, Q)$ and $U(f, Q) \leq L(f, P)$

36. (a)Suppose that $\{f_n\}$ is a monotonic sequence of a continuous function on I=[a,b] that converges on I to a continuous function f. Then prove the convergence of the sequence is uniform.

    (b) Show that the sequence $\{\frac{x^n}{1+x^n}\}$ does not converge uniformly on [0,2] by showing that the limit function is not continuous on [0,2].

37. (a) State and prove Taylor's Theorem.

(b)Let f,g be defined on [a,b] and f(a)=g(a)=0 and let $g(x) \neq 0$ for a<x<b. If f and g are differentiable and g(a)$\neq$ 0. Prove that limit of $\frac{f}{g}$ at a exists and equal to $\frac{f'(a)}{g'(a)}$.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

Sixth Semester

Core Course - MM6CRT10 : COMPLEX ANALYSIS

For BSc Mathematics (Model I)

Time: Three Hours **Maximum: 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. What is the real part of e^{iz}.
2. State Cauchy-Goursat theorem.
3. Find the value of $\int_{|z|=1} \frac{dz}{z-3}$.
4. Give an example of an entire function.
5. Define a simply connected domain.
6. When is a function said to be analytic at a point z_0.
7. Write the Maclaurin's series expansion of e^z.
8. Write the Laurent series for f(z)= $\frac{1}{z-2}$ valid for $|z| > 2$.
9. State Cauchy's residue theorem.
10. Find the residue at z=0 of the function f(z)= $\frac{1}{z^2+z}$.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Show that f(z)=z^2 is differentiable only at z=0.
12. Prove that the function f(z)=xy+iy is nowhere analytic.
13. Find Log(1-i).
14. Define cosine function of a complex variable z and show that it is an even function.
15. Evaluate$\int_{|z|=2} \frac{(z+2)dz}{z}$.
16. If C is any positively oriented simple closed contour surrounding the origin, show that $\int_C \frac{dz}{z} = 2\pi i.$.
17. Evaluate $\int_{|z|=3} \frac{dz}{z^2+1}$.
18. With the aid of remainders verify that $\sum_{n=0}^{\infty} z^n = \frac{1}{1-z}$ whenever $|z| < 1$
19. State Laurent's theorem.
20. Find the nature of singular points at $z_0 = 0$ of f(z)=$e^{\frac{1}{z}}$.
21. Define the improper integral $\int_{-\infty}^{\infty} f(x)dx$ and Cauchy's principal value of this integral.
22. State Jordan's lemma.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Prove that $f'(z) = 0$ everywhere in a domain D, then f(z) is a constant throughout D.
24. If f(z)=u+iv is analytic in a domain D , prove that u and v are harmonic in D.
25. Prove that $\sin(z_1 + z_2) = \sin z_1 \cos z_2 + \cos z_1 \sin z_2$.
26. State and prove the fundamental theorem of Algebra.
27. Let C be the arc of the circle $|z| = 2$ from z=2 to z=2i that lies in the first quadrant. Without evaluating the integral, show that $| \int_C \frac{dz}{z^2-1} | \leq \frac{\pi}{3}$
28. Obtain the Taylor's series $e^z = e \sum_{n=0}^{\infty} \frac{(z-1)^2}{n!}, |z-1| < \infty$ for the function f(z)=e^z by using (a) $f^n(1), n = 0,1,2, \ldots$ (b) writing $e^z = e^{z-1} e$.
29. Expand $f(z) = \frac{-1}{(z-1)(z-2)}$ as a power series in the domains (a)$|z| < 1$ $(b) 1 < |z| < 2$.
30. State and prove Cauchy's residue theorem.
31. Evaluate $\int_{-\infty}^{\infty} \frac{dx}{(x^2+1)^2}$.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries **15**marks.*

32. State and prove necessary and sufficient conditions of differentiability.
33. (a)State and prove Cauchy's integral formula.

    (b) If f is analytic everywhere inside and on a simple closed curve C, then for any z inside C, prove that $f'(z) = \frac{1}{2\pi i} \int_C \frac{f(s)ds}{(s-z)^2}$.
34.

    (a) State and prove Taylor's theorem.

    (b) Expand f(z)=$\frac{1}{z}$ into a Taylor's series about $z_0 = 1$.
35. Evaluate using residues to

    (a) $\int_0^{\infty} \frac{\cos ax}{x^2+1} dx, a > 0$.

    $(b) \int_0^{2\pi} \frac{d\theta}{1+a \sin \theta}, -1 < a < 1$.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Sixth Semester
Core Course - MM6CRT11: LINEAR ALGEBRA AND METRIC SPACES
For BSc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A
*Answer **all** the questions*
*Each question carries **1** mark*

1. Define the direct sum of subspaces of a vector space.
2. Write the standard basis of $F^{(4)}$.
3. Prove that **0**v=**0** for v ϵ $\boldsymbol{V}$.
4. Define null space of a linear map.
5. Define injective linear map.
6. Define open sphere in a metric space.
7. State true or false: arbitrary intersection of open sets is open.
8. Give the set of all boundary points of the $\mathbb{Q}$ in $\mathbb{R}$ with usual metric.
9. Give an example of a metric space which is not complete.
10. Is the composition of two uniformly continuous functions continuous?

$(10 \times 1 = 10)$

Section B
*Answer any **eight** questions*
*Each question carries**2** marks*

11. Write the vector(7,2,9) as a linear combination of (2,1,3) and (1,0,1).
12. Prove that every element in a vector space has a unique additive inverse.
13. What is the geometrical interpretation of scalar multiplication in $\mathbb{R}^2$.
14. If Tϵ $L(V, W)$, then prove that range T is a subspace of W
15. Give an example of $f: R^2 \to R$ such that f(av)=af(v) for all $a\epsilon$ R and all v $a\epsilon$ R^2 but f is not linear.
16. If V and W are finite dimensional vector spaces such that dim V> dim W, then prove that no linear map from V to W is injective.
17. Let (X,d) be a metric space. Prove that for $x \neq y$, ∃ disjoint open sets G and H such that $x\epsilon$ G & $y\epsilon$ H.
18. Let (X,d) be a metric space and $A \subseteq X.$ Show that cl(A) is a closed set.
19. Prove or disprove $\text{int}(A \cup B) \subseteq int(A) \cup int(B)$.
20. Let (X,d) and (Y,ρ) be metric spaces and $f: X \to Y$be a uniformly continuous function. If $\{x_n\}$is a Cauchy sequence in X, then show that $\{f(x_n)\}$ is Cauchy in Y.
21. Prove that a sequence in a discrete metric space is Cauchy iff it is eventually constant.
22. Every convergent sequence in a metric space has a unique limit.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Prove that the union of two subspaces of V is a subspace of V if and only if one of the subspaces is contained in the other.
24. Prove or give a counter example: If U_1,U_2,W are subspaces of V such that $V = U_1 \oplus W$ and $V = U_2 \oplus W$, then $U_1 = U_2$
25. Let $T \epsilon\ L(V, W)$. Then prove that T is injective if and only if null T={o}.
26. Let $T \epsilon\ L(F^2, F^3)$ be defined by T(x,y)=(x+3y, 2x+3y,7x+9y). Find the matrix of T with respect to the standard basis
27. Let (V, W) , {v_1,v_2,…,v_n}, {w_1,w_2,…,w_n} be two bases for V and W respectively. Then prove that $M(Tv) = M(T)M(v)$ for every v$\epsilon\ V$.
28. Let (X,d) be a metric space and A$\subseteq X$. Then A is closed iff A contains each of its limit points.
29. Show that every convergent sequence is cauchy.Is the converse true? Justify.
30. Let (X,d) be a metric space and A$\subseteq X$ be dense in X. Let (Y, ρ) be a complete metric space and $f: A \to Y$ be a uniformly continuous function. Then f can be extended uniquely to a uniformly continuous function $g: X \to Y$.
31. Show that every open ball is an open set and every closed ball is a closed set.

$(6 \times 4 = 24)$.

Section D

*Answer any **two** questions*

*Each question carries **15** marks.*

32. (a)In a finite-dimensional vector space, the length of every linearly independent list of vectors is less than or equal to the length of every spanning list of vectors.
    (b)Every subspace of a finite dimensional vector space is finite dimensional.

33. (a)If V is finite dimensional and $T \epsilon\ L(V, W)$, then range T is a finite dimensional subspace of W and dim V=dim null T + dim range T.
    (b) Prove that a linear map is invertible if it is injective and surjective.

34. Prove the following:

(a) The sequence space l^∞ is a complete metric space.

(b) Let (X,d)be a complete metric space. Then a subspace Y of X is complete if and only if it is closed.

35. In a metric space (X,d), show that
    (a)Arbitrary union of open sets is open.
    (b) Finite intersection of open sets is open.
    (c)Can we replace the term finite in (b) by arbitrary? Justify.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Sixth Semester
Core Course - MM6CRT12: DISCRETE MATHEMATICS AND NUMERICAL METHODS
For BSc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. Define a regular graph.
2. Give an example of complete bipartite graph which is complete.
3. Define union of two graphs.
4. Define a bridge.
5. Define an Euler tour.
6. Define a line graph.
7. What do you mean by deciphering.
8. Encrypt the message 'HAVE A GOOD DAY' using Caesar cipher.
9. Give an example of transcendental equation.
10. Write the Newton Raphson formula.

$(1\,0 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

11. State and prove the first theorem of graph theory.
12. Draw Petersen graph and find a trail of length 5.
13. Let G be a graph with no pair of adjacent edges. What can you say about the degrees of vertices in G.
14. Draw all trees on six vertices.
15. Let G be a simple graph on n vertices, with $n \geq 3$. If c(G) is complete prove that G is Hamiltonian.
16. For what values of nK_n is Euler.
17. Define monoalphabetic cipher,. Give an example.
18. What is knapsack problem.
19. If $n = pq = 274279$and $\varphi(n) = 272376$, find the primes p and q.
20. Solve $x^2 + x - 1 = 0$ graphically.
21. Compute one root of $e^x - 3x = 0$ correct to two decimal places using bisection method.
22. What are the conditions for convergence in Newton Rahsonmethod.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Define self-complementary graphs. Give examples. Draw all self-complementary graphs on four and five vertices.
24. Prove that every u-v walk contains a u-v path.
25. Prove that a tree with n vertices has $n - 1$ edges.
26. Prove that a tree is connected if and only if it contains a spanning tree.
27. Explain Konigsberg bridge problem.
28. Decipher the message 'BBOT XWBZ AWUVGK' which was produced by the autokey cipher RX.
29. Obtain all the solutions of the knapsack problem $21 = 2x_1 + 3x_2 + 5x_3 + 7x_4 + 9x_5 + 11x_6$.
30. Find the real root of the equation $xlog_{10}x - 1.2 = 0$ correct to five decimal places by Regula-Falsi method using the formula four times.
31. Find the cube root of 12 applying Newton Raphson formula twice.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries **15** marks*

32. Prove that a graph is bipartite if and only if I contains no odd cycles.
33. State and prove Dirac's theorem.
34. Encrypt the plaintext message GOLD MEDAL using the RSA algorithm with key $(n, k) = (2419, 3)$.
35. Solve $2x + y = 7, x + 2y = 5$ using Crout'smethod.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

Sixth Semester

Core Course - MM6CBT01:CHOICE BASED COURSE- OPERATIONS RESEARCH

For BSc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define convex hull of a set.
2. Find the Euclidean norm of the vector (2,-3,4)
3. Define vertex of a convex set.
4. What is a basic feasible solution of a L.P.P.
5. Write in standard form: Maximise$f = 2x + y - z$
   Subject to $2x - 5y + 3z \leq 4$
   $3x + 6y - z \geq 2$; x,y$\geq$ 0, z unrestricted
6. State general linear programming problem.
7. What are artificial variables.
8. Write the dual of the LPP
   MinimiseMaximise$f = 3x + y + 2z$
   Subject to $2x - y + 3z \geq 1$
   $x + y - z \geq 3$; x,y,$z \geq 0$.
9. Define loop in a transportation array..
10. State the condition for an unbalanced transportation problem.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Prove that all internal points of a convex set K is a convex set.
12. Determine whether the vector $[6\ 1\ -6\ 2]'$ is in the vector space generated by the vectors $[1\ 1\ -1\ 1]', [-1\ 0\ 1\ 1]', [1 - 1\ -1\ 0]'$.
13. Find the convex hull of the half lines $y = 0, x \geq 0$ and $y \geq 0, x = 0$ in E_2.
14. Find a basic feasible solution to the following system of equations:
$$x + 2y + 3z = 4$$
$$2x + 3y + 5z = 7$$
15. Determine λ for which the following equations have a non-trivial solution.
$$3x + y - \lambda z = 0$$
$$4x - 2y - 3z = 0$$

$$2\lambda x 4y + \lambda z = 0$$

16. Prove that the convex linear combinations of any two feasible solutions is a feasible solution.
17. Write a short note on unbounded solution to a LPP.
18. State complementary slackness theorem.
19. What type of problem can be solved by dual simplex method.
20. Find an initial solution using North-West Corner method

Destination

		D_1	D_2	D_3	Availability
origins	O_1	8	5	4	200
	O_2	9	3	6	200
	O_3	7	4	1	100
	Demand	300	150	50	

21. Give the mathematical model of an assignment problem.
22. Convert the following unbalanced assignment problem to a balanced one.

Job

		J_1	J_2	J_3	J_4	J_5
Machine	M_1	5	8	4	3	2
	M_2	9	6	7	3	8
	M_3	4	7	5	6	3
	M_4	8	5	9	4	2

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*
*Each question carries **4** marks*

23. State and prove Cauchy Schwartz inequality.
24. Show that the vertex of the set of feasible solutions S_F is a basic feasible solution.
25. Solve graphically the following LPP
    Minimise f(X)=5x+8y
    Subject to $3x + 2y \geq 3$
    $x + 4y \geq 4$
    $x + y \leq 5$;
    x,y$\geq$ 0.

26. Solve the phase I of the LPP
    Minimise f(X)=5x+8y

Subject to $600x + 500y \geq 3$

$2x + y \geq 80$

$x + 2y \geq 60;$

x,y$\geq$ 0.

27. Prove that the dual of the dual is the primal..
28. A farmer has to plant trees of two kinds A and B in a land of 4400 m^2 in area. Each A tree requires atleast 25 m^2 and of B tree atleast 40 m^2 of land. The annual water requirement of A is 30 units and of B is 15 units per tree, while atmost 3300 units of water is available. Also the ratio of the number of B trees to the number of A trees should not be less than 6/19 and not more than 17/8. The return per tree from A tree is expected to be one and half times as much as from B trees. What should be the number of trees of each kind so that the expected returnis maximum. Formulate it as LPP.
29. Write the step by step procedure to solve an assignment problem
30. Solve the transportation problem for maximum cost starting with the degenerate solution $x_{12} = 30, x_{21} = 40, x_{32} = 20, x_{43} = 60$

	D_1	D_2	D_3	
O_1	4	5	2	30
O_2	4	1	3	40
O_3	3	6	2	20
O_4	2	3	7	60
	40	50	60	

31. Consider a problem of assigning 4 workers to 4 jobs. The time (hours) required to complete the work is given below:

Jobs

		A	B	C	D
	1	7	10	8	9
Workers	2	-	11	10	7
	3	6	-	8	6
	4	9	9	-	5

$(6 \times 4 = 24)$

Section D

Answer any ***two****questions*

*Each question carries****15****marks.*

32. Solve using simplex method

Minimise f(X)=3x+5y+4z

Subject to $2x + 3y \leq 8$

$2y + 5z \leq 10$

$3x + 2y + 4z \leq 15$

x,y, $z \geq 0$.

33. Solve using dual simplex method.
Minimise f(X)=x+3y+2z

Subject to
$4x - 5y + 7z \leq 8$

$$2x - 4y + 2z \geq 2$$
$$x - 3y + 2z \leq 2$$

$x, y, z \geq 0$.

34. Find the minimum cost solution for the following assignment problem

	1	2	3	4	5
1	-2	-4	-8	-6	-1
2	0	-9	-5	-5	-4
3	-3	-8	-9	-2	-6
4	-4	-3	-1	0	-3
5	-9	-5	-8	-9	-5

35. Food bags have been lifted by 3 different types of aircraft A_1, A_2, A_3 from an airport and dropped in flood affected villages V_1, V_2, V_3, V_4, V_5. The quantity of food (in suitable units) that can be carried in one trip by aircraft A_i to village V_j is given in the following table. The total number of trips that A_i can make in a day is given in the last column. The number of trips possible each day to village Vi is given in last row. Find the number of trips each aircraft should make on each village so that the total quantity of food transported in a day is maximum.

	V_1	V_2	V_3	V_4	V_5	
A_1	10	8	6	9	12	50
A_2	7	3	8	4	10	90
A_3	7	9	6	10	4	60
	100	80	70	40	20	

$(2 \times 15 = 30)$

B Sc DEGREE (CBCS) EXAMINATION

Sixth Semester

Choice Based Course- MM6CBT02-FUZZY MATHEMATICS

For B Sc Mathematics (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define a fuzzy set.
2. Define strong α −cut.
3. Give an example of a continuous fuzzy complement.
4. State the axiomatic skeleton for fuzzy t-norm.
5. Number of equilibrium points for a continuous fuzzy complement.
6. Find the value of $[2,5]-[1,3]$
7. Prove that $A+B=B+A$ where A and B are fuzzy numbers.
8. Define logic operation.
9. Define quasi contradiction.
10. Define relative quantifiers.

$(1\,0 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Define height of a fuzzy set. Differentiate between normal and subnormal fuzzy sets.
12. Prove that ${}^{\alpha+}A \subseteq {}^{\alpha}A$
13. Prove that if $f(A)=\varphi$ iff $A=\varphi$.
14. State first characterization theorem of fuzzy complements.
15. Prove that $\langle \min(a,b), \max(a,b), c \rangle$ is a dual triple.
16. Prove that $u(a,b)=a+b-ab$ is a t-conorm.
17. Define a fuzzy number.
18. Show that $X=A-B$ is not a solution of the equation $A+X=B$.
19. Prove that $\overline{0} \in A-A\ and\ \overline{1} \in\ A/A\ \ for\ \overline{0} \notin A$ where A is a closed interval.
20. Define a Boolean algebra.
21. Define quasi contradiction.
22. Write a schema for expressing generalized modus ponens.

$(8 \times 2 = 16)$

Section C

Answer any ***six*** *questions*
Each question carries ***4*** *marks*

23. Prove that a fuzzy set A on $\mathbb{R}$ is convex iff $A(\lambda x_1 + (1-\lambda)x_2) \geq min[A(x_1), A(x_2)]$, for all $x_1, x_2 \in \mathbb{R}$ and all $\lambda \in [0,1]$
24. Let A, B be fuzzy sets defined on a universal set X. Prove that $|A| + |B| = |A \cup B| + |A \cap B|$.
25. Prove that the standard fuzzy intersection is the only idempotent t-norm.
26. For all $a, b \in [0,1]$ prove that $i_{min}(a,b) \leq i(a,b) \leq min(a,b)$, where i_{min} denotes the drastic intersection.
27. Given a t-norm i and an involutive fuzzy complement, prove that the binary operation u on $[0,1]$ defined by $u(a,b) = c\Big(i\big(c(a), c(b)\big)\Big), for\ all\ a, b \in [0,1]$ is a t-conorm such that $< i, u, c >$ is a dual triple.
28. Prove that $A.(B + C) \subseteq A.B + A.C$. Also prove that distributivity does not hold in general.
29. Write a note on the fuzzy equation $A.X = B$.
30. Write a note on linguistic hedges.
31. Let sets of values of variables $\mathcal{X}\ and\ \mathcal{Y}$ be $X = \{x_1, x_2, x_3\}\ and\ Y = \{y_1, y_2\}$ respectively. Assume that a proposition "If $\mathcal{X}\ is\ A\ then\ \mathcal{Y}\ is\ B$" is given, where $A = .5/x_1 + 1/x_2 + .6/x_3$ and $B = 1/y_1 + .4/y_2$. Then given a fact expressed by the proposition $\mathcal{X}\ is\ A'$ where $A' = .6/x_1 + .9/x_2 + .7/x_3$. Use generalized modus ponens to derive the conclusion in the form $\mathcal{Y}\ is\ B'$.

. $(6 \times 4 = 24)$

Section D

Answer any ***two*** *questions*
Each question carries ***15*** *marks*

32. State and prove second decomposition theorem.
33. Let u_ω denote the Yager clas of t-conorm. Prove that $\max(a,b) \leq u_\omega(a,b) \leq u_{max}(a,b)$ for all $a, b \in [0,1]$.
34. Solve $B.X = C$

$$B(x) = \begin{cases} 0, & x \leq 12, x > 32 \\ \frac{x-12}{8}, & 12 < x \leq 20 \\ \frac{32-x}{12}, & 20 < x \leq 32 \end{cases} \qquad C(x) = \begin{cases} \frac{x-6}{2}, & 6 < x \leq 8 \\ \frac{10-x}{2}, & 8 < x \leq 10 \\ 0, & otherwise \end{cases}.$$

35. Explain fuzzy propositions.

$(2 \times 15 = 30)$

B Sc DEGREE (CBCS) MODEL EXAMINATION,
Sixth Semester
Choice Based Course- MM6CBT03: TOPOLOGY

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define a topological space
2. Define a limit point of a set.
3. Give an example of a complete metric space.
4. Define closed sets in a topological space.
5. Give an example of a bounded sequence which is not a Cauchy sequence.
6. Give an example of a compact subspace of $\mathbb{R}$.
7. Find the closure of set of all rational numbers in $\mathbb{R}$ with usual metric .
8. State Tychonoff theorem
9. What is interior of Cantor set.
10. Define open ball in a metric space.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Show that the intersection of two topological spaces on a non-empty set X is a topology on X.
12. Give an example of a metrizable topological space .
13. Show that the boundary of a closed set is nowhere dense.
14. A subset of a topological space is closed if and only if cl(A)=A.
15. Let X be a topological space and A be a subset of X. Then cl(A)={x: each neighborhood of x intersects A}
16. Prove that a function f from a topological space X to another topological space Y is continuous if and only if inverse image of every open set in Y is open in X.
17. Define seperable space. Give an example of a seperable space.
18. Prove or disprove $\mathrm{int}(A \cup B) \subseteq int(A) \cup int(B)$.
19. Show that the continuous image of a compact set is compact.
20. Is the converse of Heine Borel theorem true? Justify.
21. Show that an interval in real line is connected.
22. Show that the range of a continuous real valued function on a connected set is an interval.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Show that a continuous real valued function on a compact space is bounded.
24. State and prove generalized Heine Borel Theorem
25. State and prove Lebesgue covering lemma.
26. Show that a sequentially compact metric space is compact.
27. Show that a compact metric space is seperable.
28. Show that a topological space is connected if and only if every non-empty proper subset has a non-empty boundary.
29. Prove that the product of two connected space is connected.
30. Show that the subspace of a topological space itself is topological space.
31. Why topology is often described to non-mathematicians as rubber sheet geometry.

$(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries**15** marks.*

32. Show that a topological space is compact if every subbasic open cover has a finite subcover.
33. Define locally connected space. Give an example. Show that product of any non-empty class of locally connected spaces is locally connected.
34.(a)Show that the set of all isolated points of a second countable space is countable.

(b) show that any closed subspace of a compact space is compact.

35.(a) Prove that the product of any non-empty class of connected space is connected.

(b) Show that the union of any non-empty class of connected subspaces of a topological space each pair of which intersects is connected.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

First Semester

Complementary Course - MM1CMT01 : MATHEMATICS-I-PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND NUMERICAL METHODS

For B Sc Physics and B Sc Chemistry

Time : Three Hours Maximum : 80 Marks

Use of Non-Programmable Scientific Calculator allowed.

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define partial derivative of f(x,y) with respect to x.
2. State the Mixed Derivative Theorem.
3. If the rank of a matrix is 4, what is the rank of its transpose?
4. If a non-homogenous system contains n equations in n unknowns and the determinant is non zero, what can you say about the solution of the system?
5. What is $x^n + \frac{1}{x^n}$if $x = cos\theta + isin\theta$?
6. Give an example of transcendental function.
7. Find two numbers a and b such that the roots of the equation $x^3 + x - 1$ that lies between a and b.
8. Write Newton's Raphson Formula.
9. Give the series expansion of sin z.
10. What is the period of cosh (x+iy).

(10×1=10 marks)

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Find f_{yxyz} , if $f(x, y, z) = 1 - 2xy^2z + x^2y$.
12. The plane $x = 1$ intersects the parboloid$z = x^2 + y^2$ in a parabola. Find the slope of the tangent to the parabola at (1,2,5)
13. Find the value of $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ at the point (4,-5) , if $f(x, y, z) = x^2 + 3xy + y - 1$.
14. Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \end{bmatrix}$
15. If A=$\begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}$ find A^{-1} by Cayley Hamilton Theorem.
16. Separate into real and imaginary parts log (x+iy).

17. How should we choose φ in order that the sequence $x_0, x_1, x_2, \ldots$ converge to roots in iteration method.
18. Derive the formula for finding square root of a number N using Newton's Raphson method.
19. Give a geometrical interpretation of regulafalsi method.
20. Show that $\cosh 3x = 4\cosh^3 x - 3\cosh x$.
21. Separate into real and imaginary parts the expression sin (x+iy).
22. Define idempotent matrix and give an example.

(8×2=16 marks)

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. If $f(x,y,z) = xcosy + ye^x$ find the second order derivatives $\frac{\partial^2 f}{\partial x^2}, \frac{\partial^2 f}{\partial y^2}, \frac{\partial^2 f}{\partial x \partial y}$ and $\frac{\partial^2 f}{\partial y \partial x}$
24. Find $\frac{dw}{dt}$ if $w = xy + z;\ x = \cos t, y = \sin t, z = t$.
25. Solve the system of equations:

$$x + 2y + 3z = 0$$

$$2x + y + 3z = 0$$

$$3x + 2y + z = 0$$

26. Find the characteristic equation of $\begin{bmatrix} 1 & 1 & 2 \\ 3 & 1 & 1 \\ 2 & 3 & 1 \end{bmatrix}$. Verify that it is satisfied by A and A^{-1}.
27. Find the roots of the equation $x^3 - x - 1 = 0$ using bisection method.
28. Find the roots of the equation $2x = \cos x + 3$ correct to three decimal places using iteration method.
29. Express $\frac{\sin 7x}{\sin x}$ in terms of cos x.
30. Find $\frac{dy}{dx}$, if $y^2 - x^2 - \sin xy = 0$.
31. If $u = \log\tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right)$. Prove that

    (a) $\sinh u = \tan\theta$. (b) $\tanh u = \sin\theta$

(6×4=24 marks)

Section D

*Answer any **two** questions*

*Each question carries**15**marks*

32. (a) Express $\frac{\partial w}{\partial r}$ and $\frac{\partial w}{\partial s}$ in terms of r and s , if $w = x + 2y + z^2,\ x = \frac{r}{s}, y = r^2 + \ln s,\ z = 2r$.

    (b) Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ at (0,0,0) if $x^3 + z^2 + ye^{xz} + z\cos y = 0$

33. Reduce the matrix A= $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \\ 3 & 2 & 1 \end{bmatrix}$ into its normal form and find the rank.

34. Sum the series Type equation here.

(a) $\cosh x - \frac{1}{2}\cosh 2x + \frac{1}{3}\cosh 3x - \cdots$ to infinity

(b) $\sinh x - \frac{1}{2}\sinh 2x + \frac{1}{3}\sinh 3x - \cdots$ to infinity

(c) $x\sinh \Theta + x^2 \sinh 2\Theta + x^3 \sinh 3\Theta + \cdots$ to infinity

35. (a)Find a real root of $x^3 - 2x - 5 = 0$ correct to three decimal places using the method

of false position.

(b) Find a real root of x sinx +cos x =0 using Newton's Raphson method.

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION

Second Semester

Complementary Course - MM2CMT02 : MATHEMATICS-II-INTEGRAL CALCULUS, ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

For B Sc Physics (Model I) and B Sc Chemistry (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all**the questions*

*Each question carries **1** mark*

1. Evaluate $\int_0^{\pi} 3\ cos^2$ x sin x dx.
2. Find the length of the curve x = $\frac{y^3}{3} + \frac{1}{4y}$ from y = 1 to y = 3.
3. State Fubini's theorem.
4. Evaluate $\int_0^2 \int_0^1 (4 - x - y) dx$.
5. Reverse the order of integration $\int_0^1 \int_y^{\sqrt{y}} dxdy$.
6. What is the order of an ordinary differential equation?
7. Define an integrating factor.
8. Give an example of a linear equation.
9. What is Lagrange's partial differential equation
10. Form b partial differential equation by eliminating constants a and b from the equation $z = ax + by + ab$

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*

*Each question carries **2** marks*

11. Suppose that $\int_0^1 f(x)dx = 3$.Find$\int_{-1}^0 f(x)dx$ if f is odd.
12. The region between the curve y = $\sqrt{x}$, 0 ≤ x ≤ 4 and the x- axis is revolved about the x – axis to generate b solid. Find its volume.
13. Find the arc length function for the curve f(x) = $\frac{x^3}{12} + \frac{1}{x}$.
14. Sketch the region of integration of the integral $\int_0^{\pi} \int_x^{\pi} \sin y dy dx$.
15. Evaluate the limits of integration where R is the region bounded by the lines y = x, y = 2x and x + y = 2.
16. Find the average value of f(x, y) = x cosxy over the rectangle R: 0 ≤ x ≤ π, 0 ≤ y ≤ 1.
17. Determine whether the differential equation $(2x - 1)dx + (3y + 7)dy$ is exact.
18. Find an integrating factor for the differential equation $(2y^2 + 3x)dx + 2xydy = 0$.

19. Solve the linear equation y'=8y.
20. Solve the partial differential equation $u_{xx} + 4u = 0$.
21. Solve $\frac{dx}{x} = \frac{dy}{y} = \frac{dz}{z}$.
22. Obtain the partial differential equation associated with an equation of the form
    $z = f(x^2 + y^2)$.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*
*Each question carries **4** marks*

23. 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.
24. Find the area of the region enclosed by the parabola y = 2 – x^2 and the line y = -x.
25. Find the average value of F (x, y, z) = x^2 + 9 over the cube in the first octant bounded by the coordinate planes and the planes x = 2, y = 2 and z = 2.
26. Sketch the region of integration, reverse the order of integration and evaluate the integral $\int_0^1 \int_y^1 x^2 e^{xy}$dxdy.
27. Solve the differential equation $\frac{dy}{dx} + \frac{1}{x}y = 3y^3$.
28. Find the general solution of $x\frac{dy}{dx} + (3x + 1)y = e^{-3x}$.
29. Determine whether the following differential equation is exact. If so solve
    $(3x^2y + e^y)dx + (x^3 + xe^y - 2y)dy = 0$.
30. Find the integral curves of the equations
    $\frac{dx}{y+zx} = \frac{dy}{-(x+yz)} = \frac{dz}{x^2-y^2}$.
31. Eliminate the arbitrary function f from the equation
    $z = xy + f(x^2 + y^2)$.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*
*Each question carries **15** marks*

32. (a) Find the volume of the solid generated by revolving the region in the first quadrant bounded above by the line y = $\sqrt{2}$, below by the curve y = secx tanx and on the left by the y axis, about the line y = $\sqrt{2}$.
    (b) Find the area of the region enclosed by x = y^2 – y and x = $2y^2$ -2y – 6.

33. (a)Find the volume of the region bounded above by the paraboloid z = x^2 + y^2 and below by the triangle enclosed by the lines y = x, x = 0 and x + y = 2 in the xy plane.

    (b) Find the volume of the region D enclosed by the surface z = x^2 + $3y^2$ and

$z = 8 - x^2 - y^2$.

34. Solve the following initial value problems.

(a) $x\frac{dy}{dx} + y = e^x, y(1) = 2.$

(b) $xy^2\frac{dy}{dx} + y^3 = 1, y(1) = 2.$

35. Find the general integral of the linear partial differential equation

(a) $y^2p - xyq = x(z - 2y).$

(b)Form the partial differential equation by eliminating the arbitrary function from $z = f(x + it) + g(x - it)$where $i = \sqrt{-1}.$

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Third Semester
Complementary Course - MM3CMT03: MATHEMATICS-III-VECTOR CALCULUS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA
For B Sc Physics (Model I) and B Sc Chemistry (Model I)

Time: Three Hours **Maximum: 80 Marks**

Section A
*Answer **all** the questions*
*Each question carries **1** mark*

1. If $\overline{r}$ is the position vector of a particle moving along a smooth curve in space what is the direction of motion at time t.
2. What is the length of a smoothcurve$\overline{r}(t), a \leq t \leq b$.
3. What is the curvature of a straight line.
4. Write the formula for finding the work done by the force field along the curve C from $t = a$ to $t = b$
5. State divergence theorem.
6. What is the polar equation of a circle of radius $|a|$ centered at O.
7. Find the focus of the parabola $y^2 = -16x$.
8. Sketch the circle $r = 4\cos\theta$.
9. Define a group.
10. State Cayley's theorem.

$(10 \times 1 = 10)$

Section B
*Answer any **eight** questions*
*Each question carries **2** marks*

11. Find the acceleration of the vector $\overline{r}(t) = \sec t\,\hat{\imath} + \tan t\,\hat{\jmath} + \frac{4}{3}t\hat{k}$ at $t = \frac{\pi}{6}$
12. Find the derivative of $f(x,y,z) = x^3 - xy^2 - z$ at (1,1,0) in the direction of $2\hat{\imath} + 3\hat{\jmath} + 6\hat{k}$.
13. Find the gradient of$f(x,y,z) = x^2 + y^2 - 2z^2 + z\ln x$at (1,1,1).
14. Find the curl of $\overline{F} = (x^2 - y)\hat{\imath} + 4z\hat{\jmath} + x^2\hat{k}$
15. Find the line integral of $f(x,y,z) = xy + y + z$ along the curve $\overline{r}(t) = 2t\,\hat{\imath} + t\hat{\jmath} + (2 - 2t)\hat{k}, 0 \leq t \leq 1$.
16. Using Green's theorem find the area of the ellipse $\overline{r}(t) = a\cos t\,\hat{\imath} + b\sin t\,\hat{\jmath}, 0 \leq t \leq 2\pi$
17. Find the foci and vertices of the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$.

18. Find the equation for hyperbola with eccentricity $\frac{3}{2}$ and directrix$x = 2$.
19. Replace the polar equation $r^2 = 4r\cos\theta$ by equivalent Cartesian equation.
20. Let G be a group. Prove that for all $a, b \in G$, $(a * b)' = b' * a'$
21. Draw the group table for Klein-4 group.
22. Determine whether the map $\emptyset: \mathbb{Z} \to \mathbb{R}$ defined by $\emptyset(n) = n$ is a homomorphism.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*

*Each question carries **4** marks*

23. Express acceleration of the motion $\overline{r}(t) = (t+1)\hat{\imath} + 2t\hat{\jmath} + t^2\hat{k}$ in the form $\boldsymbol{a} = a_T\boldsymbol{T} + a_N\boldsymbol{N}$.
24. Find the directions in which $f(x, y) = x^2 + xy + y^2$ (a) increases most rapidly at the point $(-1, 1)$. (b) decreases most rapidly at the point $(-1, 1)$
25. Find the work done by the force $\overline{F} = (y - x^2)\hat{\imath} + (\mathrm{z} - \mathrm{y}^2)\hat{\jmath} + (x - z^2)\hat{k}$ over the curve $\overline{r}(t) = t\hat{\imath} + t^2\hat{\jmath} + t^3\hat{k}, 0 \le t \le 1$ from $(0, 0, 0)$ to $(1, 1, 1)$
26. Find the flux of $\overline{F} = (x - y)\hat{\imath} + x\hat{\jmath}$ across the circle $x^2 + y^2 = 1$ in the xy plane.
27. Find all polar coordinates of the point $P(2, \frac{\pi}{6})$.
28. Find the hyperbolas standard form equation from the following information: Foci $(\pm 2, 0)$ and asymptotes $y = \pm\frac{1}{\sqrt{3}}x$.
29. Find the Cartesian equation for the hyperbola centered at the origin that has a focus at $(3, 0)$ and the line $x = 1$ as the corresponding directrix.
30. Define a cyclic group and prove that every cyclic group is abelian.
31. Let G be a group and let $a \in G$ then prove that $H = \{a^n / \; n \in Z\}$is subgroup of G.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*

*Each question carries**15**marks*

32. Find unit tangent vector $\boldsymbol{T}$ unit normal vector $\boldsymbol{N}$ and the curvature $\boldsymbol{\kappa}$ for the helix $\overline{r}(t) = a\cos t\,\hat{\imath} + a\sin t\,\hat{\jmath} + bt\hat{k}$.
33.
    (a) Find the area of the surface cut from the bottom of the paraboloid$x^2 + y^2 - z = 0$ by ther plane $z = 4$

    (b) Use Stokes theorem to evaluate the circulation $\oint_C \overline{F}\,.\,d\overline{r}$ if $\overline{F} = xz\hat{\imath} + xy\hat{\jmath} + 3xz\hat{k}$ and C is the boundary of the portion of the plane $2x + y + z = 2$ in the first octant.
34. Find the center, foci and vertices of the conic section $2x^2 + 2y^2 - 28x + 12y + 114 = 0$.

35. Decide whether $n\mathbb{Z}$ with usual addition and multiplication is a field.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION
Fourth Semester
Complementary Course - MM4CMT04: MATHEMATICS-IV-FOURIER SERIES, LAPLACE TRANSFORMS AND LINEAR ALGEBRA
Common for B Sc Physics (Model I) and B Sc Chemistry (Model I)

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. Find the fundamental period of $\cos nx$.
2. Give an example of an even periodic function.
3. State linearity property of Laplace transform.
4. If $f(t) = 1, t \geq 0$ find $L(f)$
5. What is $L(tf(t))$
6. Define subspace of a vector space.
7. Define basis of a vector space.
8. Define row rank of a matrix A.
9. Determine whether the correspondence between people and their weights constitute a function.
10. Define a linear transformation.

$(10 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

11. Sketch the graph of the function $f(x) = |x|$ in the interval $-\pi < x < \pi$.
12. Determine whether the function $x|x|$ is even, odd or neither even nor odd.
13. Write the Euler formulas.
14. Find the inverse transform of the function $\frac{s}{(s^2+4)^2}$
15. Find the Laplace transform of $t \cos \omega t$.
16. State first shifting theorem of Laplace transform.
17. Determine whether $\left\{\begin{bmatrix} a & b \\ c & d \end{bmatrix} \in M_{2\times 2} \,/\, b = c = 0\right\}$ is a vector space under standard matrix addition and scalar multiplication.
18. Determine whether $\boldsymbol{u} = [1 \quad 2 \quad 3]$ is a linear combination of $v_1 = [1 \quad 1 \quad 1], v_2 = [2 \quad 4 \quad 0], v_3 = [0 \quad 0 \quad 1]$.
19. Define a vector space.

20. Determine whether the transformation $T: \mathbb{V} \to \mathbb{V}$ defined by $T(v) = kv$ for all vectors v in $\mathbb{V}$ and any scalar k is linear.
21. Define $\boldsymbol{S}: \mathbb{R}^3 \to \mathbb{R}^2$by $\boldsymbol{S}[a \quad b \quad c] = [a + b \quad c]$. Find $[2 \quad -2 \quad 0]$.
22. Determine the kernel of the matrix $A = \begin{bmatrix} 1 & 1 & 5 \\ 2 & -1 & 1 \end{bmatrix}$.

$(8 \times 2 = 16)$

Section C

Answer any ***six*** *questions*

Each question carries ***4*** *marks*

23. Find the Fourier coefficients of $f(x) = \begin{cases} -1 \; if \; 0 < x < \frac{\pi}{2} \\ 0 \; if \; \frac{\pi}{2} < x < 2\pi \end{cases}$.
24. Find $a_n$and $b_n$of $f(x) = x^2$in $-2 < x < 2$.
25. Find the Laplace transform of $te^{-t} \sin t$
26. Find the Laplace transform of $\frac{5s}{s^2-25}$.
27. Determine whether the set $\{t^2 + 2t - 3, \; t^2 + 5t, 2t^2 - 4\}$ of vectors in $\mathbb{P}^2$ is linearly independent.
28. Determine the coordinate representation of the matrix$\begin{bmatrix} 4 & 3 \\ 6 & 2 \end{bmatrix}$ with respect to the basis $\mathbb{S} = \left\{ \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} \right\}$.
29. Determine the row rank of $A = \begin{bmatrix} 1 & 3 & 4 \\ 2 & -1 & 1 \\ 3 & 2 & 5 \\ 5 & 15 & 20 \end{bmatrix}$
30. Let $\boldsymbol{S}: \mathbb{V} \to \mathbb{W}$ and $\boldsymbol{T}: \mathbb{V} \to \mathbb{W}$ be to linear transformations. Let $\boldsymbol{S} + \boldsymbol{T}: \mathbb{V} \to \mathbb{W}$be defined by $(\boldsymbol{S} + \boldsymbol{T})\boldsymbol{v} = \boldsymbol{S}(\boldsymbol{v}) + \boldsymbol{T}(\boldsymbol{v})$for all$\boldsymbol{v}$in . Prove that $\boldsymbol{S} + \boldsymbol{T}$is linear.
31. Find the matrix representation with respect to the standard basis in $\mathbb{R}^2$ and tha standard basis $\mathbb{C} = \{t^2, t, 1\}$ in $\mathbb{P}^2$ for the linear transformation $\boldsymbol{T}: \mathbb{R}^2 \to \mathbb{P}^2$ defined by $\boldsymbol{T} \begin{bmatrix} a \\ b \end{bmatrix} = 2at^2 + (a + b)t + 3b$.

. $(6 \times 4 = 24)$

Section D

Answer any ***two*** *questions*

*Each question carries**15**marks*

32.

(c)Find half range sine expansion of the function $f(x) = x, 0 < x < 2$

(d)Find the Fourier series for the function $f(x) = e^x, -\pi < x < \pi$

33.

(c)Solve the initial value problem $y'' + 2y' + y = e^{-t}, y(0) = -1, y'(0) = 1$

(d)If $L(f) = \frac{1}{s(s^2+\omega^2)}$Find $f(t)$.

34. Determine whether $\mathbb{S} = \{[x \quad y \quad z] \in \mathbb{R}^3 / \, y = 0\}$ is a vector space under regular addition and scalar multiplication.

35. Find a basis for the kernels and a basis for the image of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$.

$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

First Semester

Complementary Course - MM1CSMT1 / MM1CAMT1:- DISCRETE MATHEMATICS –I- RELATIONS, LOGIC AND PROPOSITIONAL CALCULUS, LATTICES AND BOOLEAN ALGEBRA

Common for B Sc Computer Science (Model III) and BCA

Time : Three Hours Maximum : 80 Marks

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define a relation.
2. Define a compatible relation.
3. Define an equivalence relation.
4. What is the truth value of the statement ‘ Paris is in India or 2 + 2 = 4’.
5. What is a law of detachment.
6. Suppose there are 8 male professors and 5 female professors teaching a calculus class. Then in how many ways does a student can choose a calculus professor.
7. State pigeonhole principle.
8. How many committees of 3 people can be formed from 8 people.
9. When do we say that two Boolean algebras are isomorphic.
10. Write the dual of the Boolean equation (a * 1)*(0 + a') = 0.

(10×1=10 marks)

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Given A = {1, 2, 3} and B = {a, b}. Find A × B and B × B.
12. Prove that $(A \times B) \cap (A \times C) = A \times (B \cap C)$.
13. Find the number of relations from A = {a, b, c} to B = {1, 2}.
14. Let p be “It is cold” and let q be “It is raining.” Give a verbal sentence which describes $q \vee \neg p$.
15. Prove that $p \vee p \equiv p$.
16. Draw the truth table of $p \rightarrow q$.
17. Prove that $\binom{17}{6} = \binom{16}{5} + \binom{16}{6}$.
18. How many 3 digit numbers can be formed from the six digits 2, 3, 5, 6, 7 and 9 if repetitions are not permitted.
19. Find n if P(n, 2) = 72.
20. Prove that a * a = a, where a is an element in the Boolean algebra.

21. Find the output sequence Y for an AND gate with inputs A, B, C where A = 111001, B = 100101, C = 110011.
22. Let E = xy'z + x'z' + yz' = x, find E_L and E_S.

(8×2=16 marks)

Section C

*Answer any **six** questions*
*Each question carries **4** marks*

23. Give examples of relations R on A = {1, 2, 3} having the stated property
    a) R is both symmetric and antisymmetric.
    b) R is transitive but R ∪ R^{-1} is not transitive.
24. Let L be any collection of sets. Is the relation of set inclusion ⊆ a partial order on L. Justify your answer.
25. Write contrapositive, converse and inverse of the following "Indian team wins whenever match is played in Kolkota, hometown of Ganguly".
26. Show that the following argument is a fallacy p → q, ¬ p ⊢ ¬ q.
27. Prove that P(n, r) = $\frac{n!}{(n-r)!}$.
28. Assume there are three men and five women at a party. Show that if these people are lined up in a row at least two women will be next to each other.
29. Consider the Boolean algebra D_{210}, find the set A of atoms. Also find two sub algebra's with eight elements.
30. State and prove De- Morgan laws in Boolean algebra.
31. Draw the logic circuit L with inputs A, B, C and output Y which corresponds to Boolean expression Y = ABC + A'C' + B'C'.

(6×4=24 marks)

Section D

*Answer any **two** questions*
*Each question carries**15**marks*

32. (a)Let A be a set of nonzero integers and let ≈ be the relation on A × A defined by (a, b) ≈ (c, d) whenever ad = bc. Prove that ≈ is an equivalence relation.
    (b) Let A = {1, 2, 3, 4, 6} and let R be a relation on A defined by x divides y. Write R as a set of ordered pairs and draw its directed graph. Also find the inverse relation R^{-1} of R. Check whether *R* is reflexive, antisymmetric or transitive.
33. (a) Determine the validity of the argument,
    If 7 is less than 4, then 7 is not a prime number
    7 is not less than 4
    ----
    7 is a prime number.
    (b) Construct truth table for ((¬ a) ∧ c) → (b ∧ c).

34. (a)Of 32 people who save paper or bottles for recycling, 30 save paper and 14 save bottles. Find the number of people who (a) save both (b) save only paper (c) save only bottles

    (b) A bag contains six white marbles and five red marbles. Find the number of ways four marbles can be drawn from the bag if

    (i) they can be any color

    (ii) two must be white and two red

    (iii) they must all be of same color

35. (a) Let $E = xy' + xyz' + x'yz'$. Find the prime implicants of E and a minimal sum for E.

    (b) Use a Karnaugh map to find a minimum sum for $E = x'yz + x'yz't + y'zt' + xyzt' = xy'z't'$.

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION
Second Semester
Complementary Course - MM2CSMT2: DISCRETE MATHEMATICS –II- MATRICES, NUMBER THEORY AND GRAPH THEORY
Common for B Sc Computer Science (Model III) and BCA

Time: Three Hours **Maximum : 80 Marks**

Section A

*Answer **all** the questions*
*Each question carries **1** mark*

1. Define rank of a matrix.
2. Give an example of a skew symmetric matrix.
3. State true or false: A homogeneous system of equations is not always consistent.
4. What is law of trichotomy.
5. Write the fundamental theorem of arithmetic
6. Define a complete graph.
7. Give an example of a 3-regular graph.
8. A path P_n on n vertices has ... ... edges..
9. Define a tree.
10. State Cayley's theorem.

$(1\,0 \times 1 = 10)$

Section B

*Answer any **eight** questions*
*Each question carries**2** marks*

11. Show that the matrices $\begin{bmatrix} 0 & 1 & -1 \\ 4 & -3 & 4 \\ 3 & -3 & 4 \end{bmatrix}$ and $\begin{bmatrix} 4 & 3 & 3 \\ -1 & 0 & -1 \\ -4 & -4 & -3 \end{bmatrix}$ are involutary.
12. Using matrix method, solve the system of equations $x_1 + 3x_2 = 1,\ 2x_1 + 5x_2 = 3.$
13. Give the elementary transformations on a matrix that do not change the order or rank of a matrix.
14. Find the residue classes modulo m$=6$
15. Define Euler phi function $\varphi(m)$. Find $\varphi(15)$
16. Find all integers n such that $1 < 2n - 6 < 14$
17. State first theorem of graph theory. Verify the theorem with an example.
18. Draw Petersen graph and find a trail of length 5.
19. Let G be a graph with no pair of adjacent edges. What can you say about the degrees of vertices in G.
20. Draw all trees on five vertices.
21. Prove that any tree T with atleast two vertices is a bipartite graph.

22. Give an example of graph in which all the edges are bridges.

$(8 \times 2 = 16)$

Section C

*Answer any **six** questions*
*Each question carries **4** marks*

23. State Cayley Hamilton Theorem and verify it for the matrix $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.
24. Reduce to the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 1 \\ 4 & 3 & 1 \end{bmatrix}$ to its normal form.
25. Solve the system of equations using Cramer's rule
$$2x_1 + 3x_2 + x_3 = 9$$
$$x_1 + 2x_2 + 3x_3 = 6$$
$$3x_1 + x_2 + 2x_3 = 8$$
26. Prove that $\sqrt{2}$ is not rational.
27. Let $a = 8316$and $b = 10920$. Find (i) $gcd(a, b)$ (ii) Find integers m and n such that $d = ma + nb$ (iii) $lcm(a, b)$
28. Define self-complementary graphs. Give examples. Draw all self-complementary graphs on four and five vertices.
29. Prove that the numbers of edges in a complete graph $K_n$is $\frac{n(n-1)}{2}$.
30. Use Kruskal's algorithm to find a minimal spanning tree of the graph represented by the matrix$\begin{bmatrix} \infty & 1 & 4 & 1 & 3 & 3 \\ 1 & \infty & 2 & \infty & 4 & \infty \\ 4 & 2 & \infty & 2 & \infty & \infty \\ 1 & \infty & 2 & \infty & 4 & 5 \\ 3 & 4 & \infty & 4 & \infty & 3 \\ 3 & \infty & \infty & 5 & 3 & \infty \end{bmatrix}$.
31. Write the back tracking algorithm for finding a shortest path in a graph G.

. $(6 \times 4 = 24)$

Section D

*Answer any **two** questions*
*Each question carries**15**marks*

32. Determine the eigen values and associated eigenvectors of the matrix
A=$\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.

33.
(a)Prove that if $a + b \equiv a + c (mod\ m)$, then $b \equiv c (mod\ m)$
(b)Exhibit the addition and multiplication tables of Z_7.

(c) A boy sells apples for Rs.12 each and pears for Rs. 7 each. Suppose the boy collected Rs 321, how many apples and pears did he sell?

34.

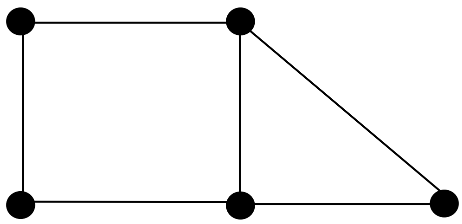
(a) Use powers of adjacency matrix to determine the graph with adjacency matrix.

$$A(G) = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 2 & 2 \\ 0 & 2 & 1 & 2 \\ 0 & 2 & 2 & 1 \end{bmatrix}$$

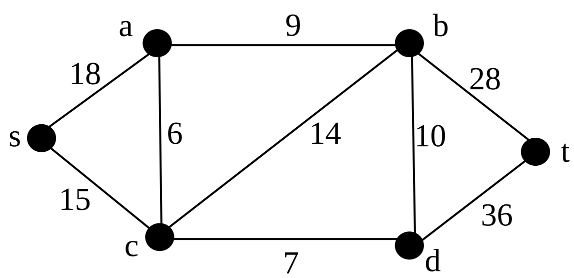
(b) Define graph isomorphism. Explain with an example. Find all non-isomorphic simple graphs on four vertices.

35.

(a) Find all spanning trees of the graph given below



(b) Use Dijkstra's algorithm on the connected weighted graph to find the length of the shortest paths from the vertex a to each of the other vertices and give examples of such paths.



$(2 \times 15 = 30)$

B Sc. DEGREE (CBCS) EXAMINATION

Third Semester

Complementary Course - MM3CSMT3 -BASIC STATISTICS AND PROBABILITY THEORY

For B Sc Computer Science (Model III)

Time: Three Hours **Maximum : 80 Marks**

Use of Non-Programmable Calculator and Statistical Tables allowed.

Section A

*Answer **all** the questions*

*Each question carries **1** mark*

1. Define Statistical Population
2. Define arithmetic mean and mention its uses.
3. Define random variable?
4. What is Box –Plot?
5. If Mean = 30Kgs, Median =27 Kg find Mode.
6. Give axiomatic definition to probability
7. Define sample space. Write the sample space if two coins are tossed simultaneously
8. Define Marginal PDF ?
9. Define questionnaire?
10. Write the mean and variance of Poisson distribution?

(10×1=10 marks)

Section B

*Answer any **eight** questions*

*Each question carries**2** marks*

11. Show that the algebraic sum of deviations of the observations taken from the arithmetic mean is zero.
12. Distinguish between relative and absolute measure of dispersion
13. How is variance affected by change of scale and origin?
14. Distinguish between census and sampling.
15. Distinguish between discrete and continuous random variable. Give one example each.
16. For a binomial variable X; n=6, and P(X=2) =9 P(X=4). Find the probability mass function.
17. State and prove addition theorem on probability for two events.
18. What is the probability of getting 53 Sundays in a leap year?
19. Find the QD and coefficient of QD for the following data

25, 18, 32, 20, 25, 48, 72, 24, 50, 25

20. What is qualitative classification ? give examples?
21. Write a short note on Pie diagram.
22. What are the main methods of collecting primary data?

(8×2=16 marks)

Section D

Answer any ***two*** *questions*
Each question carries ***15*** *marks*

23. The arithmetic mean and the standard deviation of a set of 9 items are 43 and 5 respectively. If an item of value 63 is added to the set, find the mean and standard deviation of a set of 10 items
24. Given that P(A)=1/3,P(B)=3/4 and P(AUB)=11/12,then find P(B/A).
25. In a Normal population 7% are under 35 and 89% are under 63.Find mean and variance?
26. If two dice are thrown, what is the probability that (a) the sum is greater than 8 (b) neither 7 nor 11.
27. In the frequency distribution of 100 families given below some frequencies are missing.
    Find the missing frequencies if the median is 50

Class:	0-20	20-40	40-60	60-80	80-100
Frequency:	14	?	27	?	15

28. The following data relate to the monthly expenditure of two families A and B

Items of expenditure	Expenditure in Rs.	
	Family A	Family B
Food	1600	1200
Clothing	800	600
Rent	600	500
Light and Fuel	200	100
Others	800	600

Represent the above data by percentage bar diagram

29. Define simple random sample? Explain the methods of selecting simple random sample without replacement? What are its merit and demerits?
30. A random variable X has the probability function $f(x) = \frac{1}{2}e^{-|x|}; -\infty < x < \infty$
    Obtain the variance
31. Derive the mgf of binomial distribution with parameter n and p and hence derive mean and variance of the distribution

(6×4=24 marks)

Section D

Answer any ***two*** *questions*
Each question carries ***15*** *marks*

32. Calculate the arithmetic mean and standard deviation for the following data.

Age in Years	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of Persons	8	7	15	18	22	14	10	5

33. The following is the distribution function of a discrete random variable X

X	-3	-1	0	1	2	3	5	8
F(x)	0.10	0.30	0.45	0.65	0.75	0.90	0.95	1

1. Find the probability density function of X?
2. Find P(X is even) and $P(1<x<8)$
3. $P(X=0/X<1)$
4. $P(X\geq 3/X>-1)$

34. A)State and prove Bayes theorem.

B)The chances of A, B and C becoming manager of a company are 4:2:3. The probability that bonus scheme will be introduced if A, B and C became managers are 0.3,0.5 and 0.8.The bonus scheme was introduced. What is the probability that A is appointed as the manager?

35. Explain Probability and non-probability sampling methods with suitable examples?

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION

First Semester

Complementary Course - ST1MMMT1 - Basic Statistics

Common for B Sc Mathematics and BCA

Time: Three Hours **Maximum : 80 Marks**

Use of Non-Programmable Calculator and Statistical Tables allowed.

Part A (Problems /Very Short Answer Questions)

(Answer all questions, one mark each)

1. Define Statistical Population
2. Define arithmetic mean and mention its uses.
3. Define coefficient of variation.
4. What is Box –Plot?
5. If Mean = 30Kgs, Median =27 Kg find Mode.
6. Give axiomatic definition to probability
7. Define sample space. Write the sample space if two coins are tossed simultaneously
8. What do you mean by scales of measurement?
9. Define questionnaire
10. What is meant by an impossible event?

(10×1=10 marks)

Part B (Problems/ short Answer Questions)

Answer any 8 questions. Each question carries 2 Marks.

11. Show that the algebraic sum of deviations of the observations taken from the arithmetic mean is zero.
12. Distinguish between relative and absolute measure of dispersion
13. How is variance affected by change of scale and origin?
14. Distinguish between census and sampling.
15. Write a short note systematic sampling.
16. Explain the term 'kurtosis'
17. State and prove addition theorem on probability for two events.
18. What is the probability of getting 53 Sundays in a leap year?
19. Find the QD and coefficient of QD for the following data

    25, 18, 32, 20, 25, 48, 72, 24, 50, 25
20. What is qualitative classification ? give examples?
21. Write a short note on Pie diagram.
22. What are the main methods of collecting primary data?

(8×2=16 marks)

Part C (Problems/Short Essays)

Answer any 6 questions. Each question carries 4 Marks.

23. The arithmetic mean and the standard deviation of a set of 9 items are 43 and 5 respectively. If an item of value 63 is added to the set, find the mean and standard deviation of a set of 10 items
24. Given that P(A)=1/3,P(B)=3/4 and P(AUB)=11/12,then find P(B/A).
25. What are quantiles? Give a graphical procedure to determine three important quantiles
26. If two dice are thrown, what is the probability that (a) the sum is greater than 8 (b) neither 7 nor 11.
27. In the frequency distribution of 100 families given below some frequencies are missing.
    Find the missing frequencies if the median is 50

Class:	0-20	20-40	40-60	60-80	80-100
Frequency:	14	?	27	?	15

28. The following data relate to the monthly expenditure of two families A and B

Items of expenditure	Expenditure in Rs.	
	Family A	Family B
Food	1600	1200
Clothing	800	600
Rent	600	500
Light and Fuel	200	100
Others	800	600

Represent the above data by percentage bar diagram

29. Define simple random sample? Explain the methods of selecting simple random sample without replacement? What are its merit and demerits?
30. Distinguish between raw moments and central moments. Give the first 4 central moments in terms of raw moments.
31. Explain different parts of tables?

(6×4=24 marks)

Part D (Problems / Long Essays)

Answer any 2 questions. Each question carries 15 Marks.

32. Calculate the arithmetic mean and standard deviation for the following data.

Age in Years	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80

No. of Persons	8	7	15	18	22	14	10	5

33. Find the Bowely's & moment measures of skewness for the following data

Size	10	12	15	18	20	25
Frequency	2	3	8	10	6	3

34. A)State and prove Bayes theorem.

B)The chances of A, B and C becoming manager of a company are 4:2:3. The probability that bonus scheme will be introduced if A, B and C became managers are 0.3,0.5 and 0.8.The bonus scheme was introduced. What is the probability that A is appointed as the manager?

35. Explain Probability and non-probability sampling methods with suitable examples?

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION

Second Semester

Complementary Course – ST2MMMT2 - PROBABILITY DISTRIBUTION OF RANDOM VARIABLES

For B Sc Mathematics

Time: Three Hours **Maximum: 80 Marks**

Use of Non-Programmable Calculator and Statistical Tables allowed.

Part A (Problems /Very Short Answer Questions)

(Answer all questions, one mark each)

1. Define random variable?
2. Define probability density function?
3. What is the GM of paache's and Laspyre's Index number?
4. Define scatter diagram?
5. If X and Y are independent, write the relationship between joint PDF and marginal PDF
6. What is time series?
7. What is the point of intersection of two regression lines ?
8. Compare Marginal and Conditional PDF ?
9. The coefficient of correlation between X and Y is 0.38. The covariance is 10.2. The variance of X is 16. Find the variance of Y?
10. Define Cost of Living Index Number?

(10×1=10 marks)

Part B (Problems/ short Answer Questions)

Answer any 8 questions. Each question carries 2 Marks.

11. What are the different models in a Time Series?
12. Find the value of k if $f(x) = k\left(\frac{2}{3}\right)^x, x = 1,2, ...$,is a pdf
13. If the joint pdf of two variables X and Y is given by f(x,y)=K(4-x-y) , $0<x<2$, $0<y<2$
    Find K?
14. $P(x,y)=C(x^2+y^2)$, x=-1,0,1&y=-1,1.find C?
15. Explain the properties of regression coefficients?
16. Explain the change of variable in univariate case?
17. What is curve fitting?
18. What is Moving Average Method?
19. Write the relationship between PDF and DF in continuous case?
20. Prove Invariance property of correlation coefficient under linear transformation?
21. What is seasonal variation?

22. What are the properties of the distribution function?

(8×2=16 marks)

Part C (Problems/Short Essays)

Answer any 6 questions. Each question carries 4 Marks.

23. Find the p.d.f of $Y=\sqrt{X}$, if the distribution function $F(x) = x,\ 0<x<1$
$= 1,\ x\geq1$
24. Given $f(x) = x,\ 0<x<2$
$=4-x, 2<x<4$
Find D.F and $P(0.5<x<1.5)$
25. Explain the different tests to be satisfied by a good Index number?
26. If the joint pdf of two variables X and Y is given by $f(x,y)=K(4-x-y)$, $0<x<2$, $0<y<2$
Find K & the marginal pdf of X &Y
27. Give the normal equations for fitting an exponential curve using an example?
28. Explain various Tests of Index Numbers?
29. Distinguish between simple & weighted Index numbers?
30. Two regression equations are $3x+2y-26=0$ and $6x+y-31=0$. Find(a) the means of X and Y.(b) The coefficient of correlation between X and Y
31. Explain different components of Time series?

(6×4=24 marks)

Part D (Problems / Long Essays)

Answer any 2 questions. Each question carries 15 Marks.

32. Calculate correlation coefficient for the following data

A:	15	14	12	13	16	18	11	10	17	19
B:	9	12	5	8	6	7	4	3	10	11

33. Calculate the weighted Index Number for the following data. Also verify time reversal test and factor reversal test.

Commodity	Price		No.of Units	
	In 2000	2005	2000	2005
A	6	10	50	56
B	2	2	100	120
C	4	6	60	60

D	10	12	36	24
E	8	12	40	36

34. The following is the distribution function of a discrete random variable X

X	-3	-1	0	1	2	3	5	8
F(x)	0.10	0.30	0.45	0.65	0.75	0.90	0.95	1

a. Find the probability density function of X?
b. Find P(X is even) and $P(1 < x < 8)$
c. $P(X= -3/X<0)$
d. $P(X\geq 3/X >0)$

35. The joint pdf of the random variables X&Y is $cxy, 0<x<1, 0<y<1$.

i. Find c
ii. Find the marginal pdf of X &Y
iii. Find $P(X<0.5, Y<0.5)$
iv. Are the variables Independent?

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION

Third Semester
Complementary Course – ST3MMMT3 - STANDARD PROBABILITY DISTRIBUTIONS
For B Sc Mathematics

Time: Three Hours **Maximum : 80 Marks**

Use of Non-Programmable Calculator and Statistical Tables allowed.

Part A (Problems /Very Short Answer Questions)

(Answer all questions, one mark each)

1. Define Expectation of a random variable?
2. The points of inflexion for a Normal curve are ………
3. The MGF of Exponential distribution is…………..
4. The square of Student's t distribution is…………
5. Define F distribution?
6. In case of one parameter Gamma, what is the relation connecting mean and variance?
7. The distribution of sample mean for large n is…….
8. The Bernoulli law of large numbers ,the upper bound of pq is……..
9. If X follows $F(n_1,n_2)$,then 1/F follows….
10. X and Y are independent Chi square with parameter n then Z=X/Y follows……

(10×1=10 marks)

Part B (Problems/ short Answer Questions)

Answer any 8 questions. Each question carries 2 Marks.

11. If X is a Normal variate with mean 30 and SD 5 find P(26<X<40) ?
12. The mean &variance of Binomial Distribution are 4 and ¾ respectively Find P $(X\geq 1)$?
13. Two unbiased dice are thrown. If X is the sum of the numbers showing up prove that $P\{|X-7|\geq 3\}\leq 35/54$
14. Find the relationship between Chi square and F distribution?
15. Define **t** statistic, give an example ?
16. What are the assumptions in Lind berg –Levy form of CLT?
17. Explain additive property of Binomial?
18. If 2% of the items made by a factory are defective, find the probability that there are 3 defective items in a sample of 100 items?
19. Give an example of a distribution in which mean and variance are same, and mean is half of variance?
20. Write any two properties of Expectation?

21. Find the Mode of a Binomial distribution mean = 4,SD = $\sqrt{3}$
22. Find MGF of Poisson?

(8×2=16 marks)

Part C (Problems/Short Essays)

Answer any 6 questions. Each question carries 4 Marks.

23. Derive MGF of Chi square Distribution?
24. Explain Tchebycheff's inequality?
25. Explain MGF ,Establish the relationship between the function and the moments?
26. Define statistic and sampling distribution ,Give Examples?
27. Define Beta distribution of second kind .Derive its relation with the first kind?
28. Derive recurrence relation for central moments of Binomial distribution?
29. The Joint pdf of the random variables X and Y is f(x,y) = 8xy, $0 \leq y \leq x \leq 1$.Find E(X/Y) and V(X/Y).
30. Prove Poisson as the limiting case of Binomial?
31. For a Normal distribution 38% of the observations are below 64 and 12% over 92.Find Mean and Variance?
32. If $X_1, X_2, \ldots X_n$ are n independent random variables each having Gamma distribution with parameters (λ ,n) obtain the distribution of $\sum_{i=1}^{n} Xi$

(6×4=24 marks)

Part D (Problems / Long Essays)

Answer any 2 questions. Each question carries 15 Marks.

33. If f(x,y) =2-x-y,$0 \leq x \leq 1$, ,$0 \leq y \leq 1$, Calculate Correlation between X and Y. Also find E(X/Y) and V(X/Y).
34. State and prove weak law of large numbers? If Xi is a r.v. which assumes values i and –i with equal probabilities, show that weak law of large numbers cannot be applied to the sequence X_1, X2 ,…
35. State and prove Lack of memory property . Explain the relationship between Geometric and Uniform?
36. (a) Establish the relationship between Normal,Chi square, **t, F** Distributions?
    (b) Derive the distribution of the difference of two sample means each following Normal distribution with identical variance (unknown) with small sample sizes.

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION
Fourth Semester

Complementary Course - ST4MMMT4 - STATISTICAL INFERENCE

For B Sc Mathematics

Time: Three Hours **Maximum : 80 Marks**

Time: 3 hours Max.Marks:80

Use of Non-Programmable Calculator and Statistical Tables allowed.

Part A (Problems /Very Short Answer Questions)

(Answer all questions, one mark each)

1. Define consistency?
2. What is CR Inequality?
3. Give an example for a statistic which is consistent but not unbiased?
4. Write the Confidence Interval for population variance?
5. The well known lemma used to find best critical region…………...
6. Write confidence interval for testing equality of proportions?
7. Probability of accepting the null hypothesis actually it is false is………
8. Write the test statistic for testing equality of means of two populations?
9. Name the distribution which is used in Goodness of Fit?
10. The theorem underlying in large sample test is…………?

(10×1=10 marks)

Part B (Problems/ short Answer Questions)

Answer any 8 questions. Each question carries 2 Marks.

11. Explain the Confidence Interval for large sample?
12. Explain the method of minimum variance?
13. Explain the procedure for testing equality of means of two normal populations?
14. Explain the test of independence of two attributes?
15. Write down procedure for finding best critical region?
16. Write down procedure for confidence interval for variance?
17. Define type 1 error and type 2 error.
18. Explain the test of significance for the difference of means.
19. Explain the paired sample t test
20. Write a note on Standard Error.
21. Define sufficiency . Give an example of a sufficient estimator of a given population parameter?

22. What are the sufficient set of conditions for a consistent estimator?

(8×2=16 marks)

Part C (Problems/Short Essays)

Answer any 6 questions. Each question carries 4 Marks.

23. Find sufficient statistic for p of Binomial population?
24. Derive Confidence Interval for difference of means of Normal distribution?
25. Find MLE for the parameter involved in Poisson Distribution?
26. A sample of 400 observations were taken from a population with S.D. 15. If the mean of the sample is 27, test whether the hypothesis that the mean of the population is less than 24 at 5% level .
27. Derive the test statistic in 2x2 contingency table for testing the association between the attributes ?
28. Find most power full test of testing H_0: μ= 1 against H_1: μ=2 for a Possion distribution?
29. Obtain the moment estimator of μ and σ based on n observations from $N(\mu, \sigma^2)$
30. Discuss the importance of χ^2 test. How is it used to test the association between attributes?
31. Find Power,Significance level for the following If f(x) = 1/θ, $0 < x < \theta$
    the critical region is 0.5<x<1, H0: θ=1 Vs H1: θ=2

(6×4=24 marks)

Part D (Problems / Long Essays)

Answer any 2 questions. Each question carries 15 Marks.

32. Explain the desirable properties of a good point estimator with examples?
33. If 8.6,7.9,8.3,6.4,8.4,9.8,7.2,7.8,7.5 are the observed values of a random sample of size 9 from N (μ, σ^2)
    Derive &Estimate 95% confidence interval for μ and σ^2
34. What is meant by the test of statistical hypothesis? What are the principle steps involved in statistical test? Explain the procedure for testing equality of means and equality of proportions of a large populations?
35. Explain Goodness of fit ? A die is thrown 300 times.Based on the following results test whether the die is unbiased?

X :	1	2	3	4	5	6
Freq:	44	48	54	52	56	46

(2×15=30 marks)

B Sc. DEGREE (CBCS) EXAMINATION

Third Semester

Complementary Course - ST3CAMT2 - ST3CAMT2 ADVANCED STATISTICAL METHODS

(For BCA)

Time: Three Hours **Maximum : 80 Marks**

Use of Non-Programmable Calculator and Statistical Tables allowed.

Part A (Short Answer Questions)

Answer all questions. Each question carries1 Marks.

1. Define Poisson distribution.
2. Name the distribution whose mean and variance are equal?
3. The odd moments of Normal distribution is…….
4. The mode of Binomial distribution is………
5. Define Expectation of a random variable?
6. The Geometric Mean of Regression Coefficients gives ………
7. Give an example for a statistic which is consistent but not unbiased?
8. Write the Confidence Interval for population variance?
9. Define probability density function?
10. What is the point of intersection of two regression lines ?

(10×1=10 marks)

Part B (Problems/ Paragraph Answer Questions)

Answer any 8 questions. Each question carries 2 Marks.

11. Define unbiasedness of an estimator. give an example.
12. Explain consistency.
13. What is Interval estimation?
14. Write any 2 properties of PDF &DF?
15. Find the value of k if $f(x) = k\left(\frac{2}{3}\right)^x, x = 1,2, ...$,is a pdf
16. Explain the properties of regression coefficients?.
17. Explain the necessary any sufficient condition for a sufficient statistic?
18. Derive MGF of Poisson ?
19. If X is a normal variate with mean 20 and s.d. 5, Find P(18<X<22).
20. State any four properties of Normal distribution.
21. Find the mgf of Poisson distribution with parameter λ.
22. Write the relationship between PDF and DF in continuous case?

(8×2=16 marks)

Part C (Problems/Short Essays)

Answer any 6 questions. Each question carries 4 Marks.

23. For a Binomial variable X; n=6, and P(X=2) =9 P(X=4). Find the probability mass function.
24. The mean of a normal random variable X is 50 and 8% of values are greater than 58. Find mean and standard deviation of X.
25. Derive Confidence Interval for Population Mean?
26. Derive the mgf of Binomial distribution with parameter n and p and hence derive mean and variance of the distribution
27. How correlation can be estimated from graph ?
28. Derive any 2 properties of the mgf ?
29. Two regression equations are 3x+2y-26=0 and 6x+y-31=0. Find(a) the means of X and Y.(b) The coefficient of correlation between X and Y
30. Given $f(x) = x,\ 0<x<2$
    $=4-x, 2<x<4$
    Find D.F and $P(0.5<x<1.5)$
31. If 8.6,7.9,8.3,6.4,8.4,9.8,7.2,7.8,7.5 are the observed values of a random sample of size 9 from $N(\mu,\sigma^2)$ Estimate 90% confidence interval for μ

(6×4=24 marks)

Part D (Problems / Long Essays)

Answer any 2 questions. Each question carries 15 Marks.

32. Fit Poisson distribution for the following data

X	0	1	2	3	4	5	6	7
f	632	209	63	42	26	19	5	4

33. The following is the distribution function of a discrete random variable X

X	-3	-1	0	1	2	3	5	8
F(x)	0.10	0.30	0.45	0.65	0.75	0.90	0.95	1

e. Find the probability density function of X?
f. Find P(X is even) and $P(1<x<8)$
g. $P(X= -3/X<0)$
h. $P(X\geq 3/X >0)$

34. Explain the desirable properties of a good point estimator? And1,2,4,5 is a sample from a population with p.d.f $f(x)= p(1-p)^x, x=0,1,..n$, Find Sufficient estimator of p?

35. Calculate correlation coefficient for the following data

A:	15	14	12	13	16	18	11	10	17	19
B:	9	12	5	8	6	7	4	3	10	11

15×2=30 marks)

Annexure 1a - Model Mark Cum Grade Card (I Sem)

ASSUMPTION COLLEGE, AUTONOMOUS

Section:

Student ID: Date:

MARK CUM GRADE CARD

Name of candidate :
Name of College :
Permanent Register Number (PRN) :
Degree : Bachelor of Science
Programme :
Stream : Model 1
Name of Examination : First Semester Examination Month and Year

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (C x GP)	Institution Average (IA)	Result
			External		Internal		Total						
			Awarded (E)	Max	Awarded (I)	Max	Awarded (E+I)	Max					
	Common Course I												
	Common Course II												
	Core Course												
	Complementary course I												
	Complementary course II												
	TOTAL												
	SGPA :												
	SG :												

Annexure 1b - Model Mark Cum Grade Card (VI Sem)

ASSUMPTION COLLEGE, AUTONOMOUS
(Affiliated to Mahatma Gandhi University)

Section:

Student ID: Date:

MARK CUM GRADE CARD

Name of candidate :
Name of College :
Permanent Register Number (PRN) :
Degree : Bachelor of Science
Programme :
Stream : Model 1
Name of Examination : Sixth Semester Examination April 2014

Course Code	Course Title	Credits (C)	Marks						Grade Awarded (G)	Grade Point (GP)	Credit Point (C x GP)	Institution Average (IA)	Result
			External		Internal		Total						
			Awarded (E)	Max	Awarded (I)	Max	Awarded (E+I)	Max					
	Core 9 Core 10 Core 11 Core 12 Choice Based Course Project **TOTAL** SCPA : SG :												

	Marks		Credit	GPA	Grade	Month and Year	Result
	Awarded	Max					
Semester 1 Semester II Semester III Semester IV Semester V Semester VI							
Common Course 1 Common Course II Complementary Course I Complementary course II Core + Project Generic/Open Elective Overall Programme CGPA:							

Annexure 1c - 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

Table 1

%Marks	Grade	Grade Point
95 and above	O - Outstanding	10
85 - <95	A+ - Excellent	9
75 - <85	A - Very Good	8
65 - <75	B+ - Good	7
55 - <65	B -Above Average	6
50 - <55	C - Average	5
40 - <50	D - Pass	4
Below 40 or Absent	F - Failure	0

(Decimals are to be corrected to the next higher 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 2

CPA	Grade
9.5 and above	O - Outstanding
8.5 - <9.5	A+ - Excellent
7.5 - <8.5	A - Very Good
6.5 - <7.5	B+ - Good
5.5 - <6.5	B - Above average
4.5 - <5.5	C - Average
4 - <4.5	D - Pass
<4	F - Failure

Credit point (**CP**) of a Course is calculated using the formula

$CP = C \times GP$, where C = Credit; GP = Grade Point

Credit Point Average (**CPA**) of a Semester or Programme etc. is calculated using the formula

CPA = $\frac{TCP}{TC}$, where TCP = Total Credit Point;

TC = Total Credit

NOTE

A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% 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. Candidates who secure **D grade** and above will be eligible for higher studies.