SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA, 682013

CURRICULUM AND SYLLABUS

FOR

B.Sc. MATHEMATICS

CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS)

INTRODUCED FROM 2023 ADMISSIONS ONWARDS

Prepared by

Board of Studies in Mathematics

Sacred Heart College Thevara, Kochi.

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SACRED HEART COLLEGE (AUTONOMOUS), THEVARA, KOCHI, KERALA

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1. INTRODUCTION

The Department of Mathematics was established in 1944. The Department was initially under the University of Madras and subsequently got affiliated to Mahatma Gandhi University, Kottayam. In 1999, the post-graduate programme. The team of highly qualified faculty aims to develop a Centre of Excellence in Mathematical Science and inter disciplinary Mathematics. Several new initiatives in this direction have taken shape over the last few years and has enabled students to develop a focused approach to their curriculum and develop themselves into national and international leagues. During the course period they study pure and applied mathematics, the foundations of mathematical physics and statistics through which the students develop quantitative skills and ability to think clearly and critically about complex problems.

The Undergraduate programme in Mathematics include (1) Common courses, (2) Core courses,(3) Choice Based Courses, (4) Open Courses, (5) Project, (6) Complementary Courses. The students can choose one language course from among French, Hindi and Malayalam. Open course may be offered in any subject and the student shall have the option to do courses offered by other departments other than Mathematics in the fifth semester. Every student has to do a project during the 6th semester. The topics for the project can be selected as early as the beginning of the 5th semester. Physics and Statistics are the Complementary Courses during the first four semesters. Department of Mathematics offers the open course ‘Applicable Mathematics’ to the other streams during the fifth Semester.

1.1 Outcome Based Education (OBE)

Undergraduate Programme in Mathematics follows the Outcome-based Education (OBE) framework. OBE is a system where all the parts and aspects of education are focused on the outcomes of the course. The students take up courses with a certain goal of developing skills or gaining knowledge and they have to complete the goal by end of the course. Outcome-based education affirms teachers as facilitators, rather than lecturers. In this model, teachers guide the students and encourage them to develop their knowledge and skills. The undergraduate programme at the Department of Mathematics, Sacred Heart College (Autonomous), Thevara provides a learning approach in which students develop analytical ability and critical thinking and research acumen over different situations

1.2 Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

The syllabus is framed in the Outcome Based Education (OBE) framework and the Programme Outcomes (POs) are given in the table below:

Programme Outcomes (POs)	
PO1	Critical Thinking and deep domain knowledge
PO2	Effective Communication
PO3	Contributes to nation building
PO4	Care for environment
PO5	Ethical values
PO6	Global Perspective

The Programme Specific outcomes are at the end of the programme a student should be able to:

PSO1: Understand the basic concepts and tools of mathematical logic, Set theory, Theory of Equations and Number Theory.

PSO2: Understand the concepts of Geometry, Trigonometry, Calculus and Analysis, Abstract structures, Algebra, Methods of proofs and Differential Equations.

PSO3: Translate real world problems into mathematical problems and find solutions for them.

PSO4: Understand the applications of mathematics in other sciences, engineering and discuss Human Rights and Mathematics for Environmental Studies

1.3 Eligibility for Admission

Academic eligibility should be satisfied as on the last date of submission of academic data. In the case of candidates who have passed examinations of other Boards/ Institutes/Governments, except CBSE/CISCE, they shall be admitted only if these examinations have been declared equivalent to the qualifying examinations of MG University.

If an applicant for admission is found to have indulged in ragging in the past or if it is noticed later that he/she had indulged in ragging, admissions shall be denied or he/she shall be expelled from the educational institution.

No candidate shall be admitted to the degree programme unless he/she possess the qualifications and minimum requirements thereof. There is no age limit for applying to various UG programmes conducted in colleges affiliated to the University

2. REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDER GRADUATE PROGRAMMES -2023

Preamble

Sacred Heart College, Thevara became an autonomous college under Mahatma University Kottayam in 2014. Since then, academic programmes of the college are being conducted as per the curriculum and syllabus approved by the various Boards of studies and the academic council of the college. The college revised the syllabi of the under graduate (UG) programmes in 2015-16 and 2019-20. The curriculum and syllabus under the choice-based credit and semester system (CBCSS) for the under graduate programmes effective from 2019-20 admissions offer Outcome Based Education (OBE). The new 'REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDER GRADUATE PROGRAMMES -2023' is a continuation of the effort of the college for providing best education to the UG students of the college.

2.1 Title

These regulations shall be called **"SACRED HEART COLLEGE THEVARA REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) FOR UNDER GRADUATE PROGRAMMES -2023**

2.2 Scope

Applicable to all under graduate (UG) programmes of the college with effect from 2023 admissions onwards, except otherwise approved by the Academic Council of the College

2.3. Definitions

i. '**Programme**' means the entire course of study and examinations.

ii. 'Duration **of Programme'** means the period of time required for the conduct of the programme. The duration of under graduate programmes shall be 6 semesters, post-graduate programme shall be of 4 semesters and M Phil programmes shall be 2 semesters.

iii. **'Semester'** means a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days, each with 5 contact hours of one hour duration

iv. **'Course'** means a segment of subject matter to be covered in a semester. Each Course is to be designed variously under lectures / tutorials / laboratory or fieldwork / study tour /seminar / project / practical training / assignments/evaluation etc., to meet effective teaching and learning needs.

v. '**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 all students undergoing undergraduate programmes (Model I)

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

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

viii. '**Open course'** means a course outside the field of his/her specialization, which can be opted by a student.

ix. '**Additional core course**' means a compulsory course for all under graduate students (as per the UGC directive) to enrich their general awareness.

x. The U.G. programmes shall include (a) Common courses (b) Core courses (c) Complementary Courses (d) Open Course (e) Study tour and (f) Internship for selected programmes.

xi. '**Additional Course'** is a course registered by a student over and above the minimum required courses.

xii. **'Credit' (Cr)** of a course is the numerical value assigned to a course according to the relative importance of the content of the syllabus of the programme.

xiii. '**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 OR curricular activities/courses completed for value addition, as directed by the College/ department. It is the numerical value assigned to Club activities, social service, Internship, add on courses etc. which is not added with the total academic credits of the students. Additional credit components

(a) Talent & career club activity (optional)

(b) Social service (mandatory)

(c) Internship for Commerce, Communication and Computer applications (mandatory).

(d) Internship (desirable for other programmes).

(e) Add on courses (optional)

xiv. '**Programme Credit'** means the total credits of the UG Programme.

xv. **'Programme Elective course'** Programme Elective course means a course, which can be chosen from a list of electives and a minimum number of courses is required to complete the programme.

xvi. '**Programme Project'** Programme Project means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department / any appropriate Institute in order to submit a dissertation on the project work as specified.

xvii. '**Internship**' is on-the-job training for professional careers.

xviii. '**Plagiarism**' Plagiarism is the unreferenced use of other authors' material in dissertations and is a serious academic offence.

xix. '**Tutorial'** Tutorial means a class to provide an opportunity to interact with students at their individual level to identify the strength and weakness of individual students.

xx. '**Seminar'** seminar means a lecture by a student expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

xxi. '**Evaluation'** means every course shall be evaluated by 25% continuous (internal) assessment and 75% end course/end semester (external) assessment.

xxii. '**Repeat course'** is a course that is repeated by a student for having failed in that course in an earlier registration.

xxiii. **'Audit Course'** is a course for which no credits are awarded.

xxiv. '**Department'** means any teaching Department offering a course of study approved by the college / Institute as per the Act or Statute of the University.

xxv. '**Parent Department'** means the Department which offers a particular UG/PG programme.

xxvi. '**Department Council'** means the body of all teachers of a Department in a College.

xxvii. **'Faculty Advisor'** is a teacher nominated by a Department Council to coordinate the continuous evaluation and other academic activities undertaken in the Department.

xxviii. '**College Co-ordinator** means a teacher from the college nominated by the College Council to look into the matters relating to CBCSS

xxix. **'Letter Grade'** or simply '**Grade**' in a course is a letter symbol (O, A, B, C, D, etc.) which indicates the broad level of performance of a student in a course.

xxx. Each letter grade is assigned a **'Grade point'** (GP) which is an integer indicating the numerical equivalent of the broad level of performance of a student in a course.

xxxi. **'Credit point'** (CP) of a course is the value obtained by multiplying the grade point (GP)

by the Credit (Cr) of the course CP=GP x Cr.

xxxii. '**Semester Grade point average'** (SGPA) is the value obtained by dividing the sum of credit points (CP) obtained by a student in the various courses taken in a semester by the total number of credits taken by him/her in that semester. The grade points shall be rounded off to two decimal places. SGPA determines the overall performance of a student at the end of a semester.

xxxiii. **Cumulative Grade point average'** (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits and shall be rounded off to two decimal places.

xxxiv. '**Grace Marks'** means marks awarded to course/s, as per the orders issued by the college from time to time, in recognition of meritorious achievements in NCC/NSS/Sports/Arts and cultural activities.

2.4 ATTENDANCE

Being a regular college, physical presence in the regular activities, especially, classes and exams, is mandatory for the students. However, if a student secures 75% of attendance s/he is eligible to appear for the exams, provided there are no other impediments like disciplinary proceedings, malpractice record etc.

i. A maximum of 5 marks (5%) for a course is given for attendance

ii. **Absence:** A student found absent for one hour in the forenoon or afternoon session is deprived of the attendance for the entire session as far as eligibility for final exam is concerned.

iii. The hour related calculation in a course is meant for awarding marks for the course concerned.

iv. **Late entry**: A student is supposed to be in time in the class. Late arrival related treatment is left to the discretion of the individual teacher. However, as a norm, a late arriving student may be permitted to the class, if it is not inconvenient or distraction to the class as such; though attendance MAY NOT BE GIVEN. Late arrival beyond 5 minutes is treated as ABSENCE; though the teacher may consider permitting the student to sit in the class.

v. **Leave**: A student has to formally report his/her absence with reasons either in advance, or immediately after the absence for obtaining an approved leave. This applies to all sorts of leave – medical, on duty or other.

vi. The student is supposed to report in prescribed format on the very next day of the absence; however, upto a week's time is permitted. Afterwards, the leave applications will not be considered.

vii. The student has to retain a copy/section of the approved leave form and produce the same as proof, in case there is any confusion regarding the leave sanctioning. In the absence of such proof, the claims will not be entertained.

viii. **Duty Leave**: A student representing the college in sports, arts, social service or academic matters, has to get sanction from the class teacher concerned and submit the leave application form duly endorsed by teacher concerned & the class teacher, and submit it to the faculty Dean (or Vice Principal). The same will be forwarded by the Dean/Vice Principal for attendance entry.

SPORTS: The approval of the Department of Physical Education and the class teacher is required. The time limit for submission mentioned above is applicable in the case of duty leave as well.

ix. **CONDONATION**: a student may have the privilege of condonation of attendance shortage (upto a maximum of 10 days) on the basis of genuineness of the grounds of absence (medical reasons or college duty), duly recommended by the department. This is not a matter of right. It is a matter of privilege based on Principal's discretion and the good conduct of the student on the campus. A student of UG programme may have a maximum of two such opportunities.

x. **RE-ADMISSION** – a student whose attendance is inadequate will have to discontinue the studies. Such students, whose conduct is good, may be re-admitted with the approval of Governing Body, on the basis of recommendation from the department, and assurance from the student and the guardian regarding good conduct and compliance in academic and discipline matters. For this the prescribed re-admission fee has to be paid.

As a condition for re-admission, the student should have cleared all academic arrears, or should have appeared for the exams in which he/she is having an arrear (if the results are not out), and should have fulfilled all academic assignments prescribed by the department for compensating for his lack of attendance.

xi. **UNAUTHORISED ABSENCE & REMOVAL FROM ROLLS**: A student absent from the classes continuously for 10 consequent days without intimation or permission, shall be removed from the rolls, and the matter intimated to the student concerned. On the basis of recommendation of the department concerned, re-admission process may be permitted by the Principal.

2.5 PROGRAMME REGISTRATION

i. A student shall be permitted to register for the programme at the time of admission.

ii. A UG student who registered for the programme shall complete the same within a period of 12 continuous semesters from the date of commencement of the programme.

2.6 PROMOTION: A student who registers for the end semester examination shall be promoted to the next semester. However, in extreme circumstances, a student having sufficient attendance who could not register for the end semester examination may be allowed to register notionally by the Principal with the recommendation of the Head of the department concerned and, by paying the prescribed fee.

2.7 UNDER GRADUATE PROGRAMME STRUCTURE

Model I BA/B.Sc.

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

2.8 EXAMINATIONS

All the End Semester Examinations of the college will be conducted by the Controller of Examination. The Principal will be the Chief Controller of Examinations. An Examination committee consists of the Chief Controller of Examinations, Controller of Examinations, Additional Chief Superintendent, Deans, IQAC Coordinator and other faculty members nominated by the Principal will act as an advisory body of the matters relating to the conduct of examinations.

2.9. EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts;

a. Continuous Internal Evaluation (CIA) and
b. End Semester Examination (ESE).

The internal to external assessment ratio shall be 1:3, for both courses with or without practical except for (i) BA Animation and Graphics (ii) BA Animation and Visual effects and (iii) BBA. For courses without practical, there shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation. For courses with practical, generally external evaluation shall be for a maximum of 60 marks and internal evaluation for 20 marks. Both internal and external evaluation shall be carried out in the mark system and the marks are to be rounded to the nearest integer.

The internal to external assessment ratio for BA Animation and Graphics, BA Animation and Visual effects and BBA shall be decided by the respective Board of studies subject to a minimum of 60 marks for external examinations.

2.9.1. Continuous Internal Assessment (CIA)/ Continuous Assessment: The internal

evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars/viva/field survey and attendance in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The marks assigned to various components for internal evaluation as follows.

Components of Internal Evaluation (for theory without practical)

	Components	**Marks**
i.	Assignments	5
ii	Seminar/Quiz/Field survey /Viva etc.	5
iii	Attendance	5
iv	Two Test papers(2x5)	10
	Total	25

i. **Assignments**: Every student shall submit one assignment as an internal component for every course.

Components	**Marks**
Punctuality	1
Content	2
Conclusion	1
. Reference/Review	1
Total	**5**

ii. **Seminar**: The seminar lecture is expected to train the student in self-study, collection of relevant matter from the books and Internet resources, editing, document writing, typing and presentation.

Components	**Marks**
Content	2
Presentation	2
Reference/Review	1
Total	**5**

iii. Evaluation of Attendance

The attendance of students for each course shall be another component of internal

assessment.

% of attendance	Mark
Above 90%	5
Between 85 and below 90	4
Between 80 and below 85	3
Between 76 and below 80	2
Between 75 and below 76	1

Components of Internal Evaluation (for theory with practical)

Components of Theory – Internal Evaluation	**Marks**
Attendance	5
Seminar/ Assignment (Written assignments, preparation of models, charts, posters etc., field survey, field work)	5
Test paper(s)	10
Total	20

Components of Practical - Continuous internal assessment

Components	**Marks**
Attendance and Lab involvement	2
Record	2
Viva/Model Exam	1
Total	5

iv. Class Tests: Every student shall undergo **two class tests** as an internal component for every course.

2.9.2 End Semester Examination (ESE): The End Semester Examination in theory courses

shall be conducted by the college with question papers set by external experts/ question bank. The evaluation of the answer scripts shall be done by the examiners based on a well-defined scheme of evaluation given by the question paper setters/Prepared as per the direction of the Chairman, Board of Examiners. The evaluation of the End Semester Examinations shall be done immediately after the examination preferably through the centralised valuation.

2.9.3 Project

Project work is a part of the syllabus of most of the programmes offered by the college. The guidelines for doing projects are as follows:

i. Project work shall be completed by working outside the regular teaching hours.
ii. Project work shall be carried out under the supervision of a teacher in the concerned department or an external supervisor.
iii. A candidate may, however, in certain cases be permitted to work on the project in an industrial / Research Organization/ Institute on the recommendation of the Supervisor.
iv. There should be an internal assessment and external assessment for the project work in the ratio 1:3
v. The external evaluation of the project work consists of valuation of the dissertation (project report) followed by presentation of the work and viva voce.
vi. The mark and credit with grade awarded for the program project should be entered in the grade card issued by the college.

Components of Internal Evaluation for Projects

Components	**Marks**
Topic/Area selected	2
Experimentation/Data collection	5
Punctuality-Regularity	3
Compilation	5
Content	5
Presentation	5
Total	**25**

2.9.4 Comprehensive Viva-voce

Comprehensive Viva-voce shall be conducted at the end of the programme, which

covers questions from all courses in the programme as per the syllabus.

2.10. Grade and Grade Points

For all courses (theory & practical), Letter grades and grade point are given on a 10-point scale based on the total percentage of marks, (CIA+ESE) as given below:-

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

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

SGPA/CGPA	Grade
Equal to 9.5 and above	***S 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 4.5 and below 5.5	***C Average***
Equal to 4.0 and below 4.5	***D Pass***
Below 4.0	***F Failure***

A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the end semester examination for the same semester, subsequently. A student who fails to secure a minimum marks/grade for a pass in a course can be permitted to write the examination along with the next batch.

After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below. For the successful

completion of semester, a student should pass all courses and score at least the minimum CGPA grade **'D'**. However, a student is permitted to move to the next semester irrespective of her/his SGPA.

Credit Point (CP) of a course is calculated using the formula
CP = Cr x GP, where Cr = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

SGPA = TCP/TCr, where

TCP = Total Credit Point of that semester $= \sum_1^n \mathrm{CPi}$**;**

TCr = Total Credit of that semester $= \sum_1^n \mathrm{Cri}$

Where n is the number of courses in that semester

Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

$$\textbf{CGPA} = \sum(\mathrm{SGPA} \times \mathrm{TCr}) \Big/ \sum \mathrm{TCr}$$

SGPA/CGPA shall be round off to two decimal places

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board/website at least one week before the commencement of external examination. There shall not be any chance for improvement for internal mark.

The course teacher and the faculty advisor shall maintain the academic record of each student registered for the course which shall be forwarded to the controller of examinations through the Head of the Department and a copy should be kept in the department for at least two years for verification.

2.11. Registration for the examination

a. All students admitted in a programme with remittance of prescribed fee are eligible for the forthcoming semester examinations.

b. Online application for registration to the various End Semester Examinations shall be forwarded to the CE along with prescribed fee for each course in prescribed format.

c. The eligible candidates who secure the prescribed minimum attendance of the total duration of the course and possess other minimum qualification prescribed in the regulations for each course shall be issued the hall tickets. The hall ticket shall be downloaded by the students from the college website.

d. The mode of fee remittance shall be through the prescribed bank.

2.12. Supplementary Examinations

Candidates who failed in an examination can write the supplementary examination conducted by the College along with regular examinations.

2.13. Improvement of Examination

A candidate can improve his/her marks once by appearing again for the examination with the subsequent batch with the remittance of prescribed fee. In such cases the better of the two marks shall be taken as the marks awarded to him.

Internal assessment marks shall be carried over to the subsequent semester examination.

There shall not be any provision for improving internal assessment marks.

2.14. Promotion to the Next Higher Semester

A candidate shall be eligible for promotion from one semester to the next higher semester if,

a. He / she secures a minimum 75 % attendance and registered for the End Semester Examination of the programme for which he/she is studying.

b. His / her progress of study and conduct are satisfactory during the semester completed, as per the assessments recorded by the course teachers and the Head of the Department concerned.

2.15 Certificates

1. Degree certificates are issued by the Mahatma Gandhi University, Kottayam as per the act and statues of the University on the submission of the consolidated mark / score cards of the students by the College.
2. A consolidated mark / scored card shall be issued to the candidates after the publication of the results of the final semester examination taken by the candidate.
3. A Course Completion Certificate with classification shall be issued to students till the provisional certificate is issued by the university.

2.16. Award of Degree

The successful completion of all the courses with ‘D’ grade shall be the minimum requirement for the award of the degree.

2.17. Monitoring

There shall be a Monitoring Committee constituted by the principal consisting of faculty advisors, HoD, a member from teaching learning evaluation committee (TLE) and the Deans to monitor the internal evaluations conducted by college. The Course teacher, Class teacher and the Deans should keep all the records of the internal evaluation, for at least a period of two years, for verification.

Every Programme conducted under Choice Based Credit System shall be monitored by the College Council under the guidance of IQAC Coordinator, Controller of Exams, academic deans and HoDs.

2.18. Grievance Redressal Mechanism

In order to address the grievance of students regarding Continuous internal assessment (CIA) a three-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: At the level of the concerned course teacher

Level 2: At the level of a department committee consisting of the Head of the Department, a coordinator of internal assessment for each programme nominated by the HoD and the course teacher concerned.

Level 3: A committee with the Principal as Chairman, Dean of the Faculty concerned, HOD of the department concerned and one member of the Academic council nominated by the principal every year as members.

2.19. DETAILED DISTRIBUTION OF COURSES

CBCSS: **B.Sc. MATHEMATICS PROGRAMME STRUCTURE**

SI.No.	Course	Course Type	Course Category	Course Stream	Hours per Week	Credit
	SEMESTER I					
1	Homo Loquens: Effective Listening and Speaking	Theory	Common Course -1	English	5	4
2	Pearls from the Deep	Theory	Common Course-1	English	4	3
3	Additional Language I	Theory	Common Course- 2	Additional Language	4	4

4	Calculus	Theory	Core	Mathematics	4	3
5	Properties of Matter and error analysis	Theory & Practical	Complementary	Physics	4	2
6	Fundamentals of Statistics	Theory	Complementary	Statistics	4	3
				Total	25	19
	SEMESTER II					
7	Text and Context: A Guide to Effective Reading and Writing	Theory	Common Course -1	English	5	4
8	Savouring the Classics	Theory	Common Course -1	English	4	3
9	Additional Language II	Theory	Common Course- 2	Additional Language	4	4
10	Advanced Calculus and Trigonometry	Theory	Core	Mathematics	4	3
11	Theory of Probability and Random variables	Theory	Complementary	Statistics	4	3
12	Mechanics and Astrophysics	Theory & Practical	Complementary	Physics	4	2+2
				Total	25	21
	SEMESTER III					
13	Scripting the Nation: Readings on Indian Polity, Secularism and Sustainability	Theory	Common Course -1	English	5	4

14	Additional Language III	Theory	Common Course- 2	Additional Language	5	4
15	Vector Calculus, Theory of Equations and Matrices	Theory	Core	Mathematics	5	4
16	Modern Physics and Electronics	Theory & Practical	Complementary	Physics	5	3
17	Theory of Distributions	Theory	Complementary	Statistics	5	4
				Total	25	19
	SEMESTER IV					
16	Illuminations	Theory	Common Course -1	English	5	4
17	Additional Language IV	Theory	Common Course- 2	Additional Language	5	4
17	Fourier Series, LaplaceTransforms, Numerical Methods and Number Theory	Theory	Core	Mathematics	5	4
19	Optics and Electricity	Theory & Practical	Complementary	Physics	5	3+2
20	Statistical Inference	Theory	Complementary	Statistics	5	4
				Total	25	21
	SEMESTER V					
21	Real Analysis - 1	Theory	Core		6	4
22	Differential	Theory	Core		6	5

	equations					
23	Algebra	Theory	Core		5	4
24	Human Rights and Mathematics for Environmental studies	Theory	Core		4	4
25	Open Course	Theory	Open course	Open course	4	3
				Total	25	20
	SEMESTER VI					
26	Real Analysis - 2	Theory	Core		5	4
27	Complex analysis	Theory	Core		5	4
28	Linear algebra	Theory	Core		5	4
29	Graph theory and metric spaces	Theory	Core		5	4
30	Elective (One elective from the list of electives)	Theory	Core		4	3
31	Project		Core		1	1
				Total	25	20

Total marks (internal + external) for each course (without practical) is 100

2.20. QUESTION PAPER PATTERN

Questions shall be set to assess knowledge acquired, standard application of the knowledge, application of knowledge in new situation, critical evaluation of knowledge and the ability to synthesize knowledge. The question paper setter shall ensure that the questions are set in such a manner that it will test the mathematical skills of the students. The question paper shall contain short, medium and long essay type questions. More thrust shall be given to problems

QUESTION PAPER PATTERN FOR THE CORE COURSES

	PART – A	PART - B	PART - C
Number of questions	12	8	4
Marks per question	2	5	10
Maximum Marks from each part	20	25	30

2.21 Mathematics Core Courses

Semester	Course code	Name of the course	No.of hours per week	Total credits	End semester exam duration
1	23U1CRMAT01	Calculus	4	3	3 Hrs
2	23U2CRMAT02	Advanced Calculus and Trigonometry	4	3	3 Hrs
3	23U3CRMAT03	Vector Calculus, Theory of Equations and Matrices	5	4	3 Hrs
4	23U4CRMAT04	FourierSeries, LaplaceTransforms, Numerical Methods and Number Theory	5	4	3 Hrs
5	23U5CRMAT05	Real Analysis - 1	6	4	3 Hrs
5	23U5CRMAT06	Differential Equations	6	5	3 Hrs
5	23U5CRMAT07	Algebra	5	4	3 Hrs
5	23U5CRMAT08	Human Rights and Mathematics for	4	4	3 Hrs

		Environmental studies			
6	23U6CRMAT09	Real Analysis- 2	5	4	3 Hrs
6	23U6CRMAT10	Complex Analysis	5	4	3 Hrs
6	23U6CRMAT11	Linear Algebra	5	4	3 Hrs
6	23U6CRMAT12	Graph Theory and Metric Spaces	5	4	3 Hrs
6	23U6CRMAT13	Operations Research	4	3	3 Hrs
6	23UCRMAT14	BasicPython Programming and Typesetting in LaTeX	4	3	3 Hrs
6	23UCRMAT15	Numerical Analysis	4	3	3 Hrs
6	23U6PJMAT1	Project	1	1	NIL

2.22 Mathematics Complementary Courses

Semester	Course code	Name of the course	contact hours per week	Total credits	End semester exam duration
1	23U1CPMAT01	Calculus- 1	4	3	3 Hrs
2	23U2CPMAT02	Calculus-2 and Numerical Analysis	4	3	3 Hrs
3	23U3CPMAT03	Differential Equations, Matrices and Trigonometry	5	4	3 Hrs
4	23U4CPMAT04	FourierSeries, LaplaceTransforms, FourierTransforms, and	5	4	3 Hrs

		Groups			

3. SYLLABUS OF CORE COURSES OF B. Sc MATHEMATICS PROGRAMME

Core Course-1

Course Title	**Calculus**
Course Code	23U1CRMAT01
Semester	1
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Text Book: CALCULUS, by Howard Anton, Irl Bivens, Stephen Davis. (10th Edition), Wiley Student Edition.

Course Objectives:

The objective of the course is to

1) familiarise the students with the various applications of derivatives and definite integrals.
2) introduces Rolle's Theorem, Lagrange's Mean Value Theorem and their applications.
3) Introduce L'Hospital's rule for computing limits of indeterminate forms and hyperbolic functions and their derivatives.
4) Familiarise functions of more than one variable and consequently find partial derivatives.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Determine whether a given function is increasing or decreasing.	PO1/PSO2	A	PK	6	0
CO2	Apply the concepts of maxima and minima of a function to real world problems	PO1/PSO2	A	P	6	0
CO3	Compute the Limits using L'Hospitals rule.	PO1/PSO2	AP	P	10	0
CO4	Apply Rolle's Theorem and Mean Value theorem to solve real world problems.	PO1/PSO2	A	P	14	0
CO5	Compute the area and volume of solids using definite integrals	PO1/PSO2	A	P	18	0
CO6	Calculate the partial derivatives, maxima and minima of functions of more than one independent variable and use the Lagrange Multiplier method for extremum problems.	PO1/PSO2	U	C	18	0
	Total Number of Hours				72	0

Bridge Course (No questions are to be asked from this section)

Functions, Limits (an intuitive approach), computing limits, tangent lines and rates of change, the derivative function, Techniques of differentiation, indefinite integral, definite integral, Fundamental theorem of Calculus, techniques of integration.

(Sections 0.1,1.1- 1.2, 2.1-2.7, 4.1-4.6 of the text)

Module I (18 hrs)

Analysis of Functions; Increase, Decrease and Concavity, Relative Extrema, Graphing (Polynomials and rationals only), Absolute Maxima and Minima

(Relevant topics of sections 3.1-3.4 of the text)

Module II (18 hrs)

Rolle's Theorem, Mean Value Theorem, L Hospital's Rule; Indeterminate Forms, Hyperbolic Functions

(Sections 3.8 and 6.5 and 6.8 of the text)

Module III (18 hrs)

Applications of the definite integral in geometry, science and engineering. Area between two curves, Volumes by slicing; Disks and washers, Volumes by cylindrical shells, Length of a plane curve, area of a surface of revolution.

(Sections 5.1-5.5 of the text)

Module IV (18 hrs)

Functions of two or more variables, Partial derivatives, The chain rule, Maxima and minima of functions of two variables, Lagrange multipliers.

(Sections 13.1-13.3, 13.5, 13.8-13.9 of the text)

References

1) Thomas Calculus by Maurice Weir, Joel Hass, Frank R Giordano (14^{th} edition), Pearson Education

2) Calculus: (Vol 1) One Variable Calculus with an introduction to Linear Algebra by Tom M Apostol (2^{nd} Edition), 2016, Wiley Student Edition.

3) Advanced Calculus, Schaum's outlines, by Robert C Wrede and Murray Spiegel. (2^{nd} Edition), 2005, Tata McGraw-Hill.

4) Calculus and Its Applications by Larry J Goldstein, David C Lay, David I Schneider and Nakhle H Asmar (12^{th} Edition), 2010, Pearson Education.

5) Calculus Early Transcendentals, by James Stewart (5^{th} Edition), 2007, Thomson Learning.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course 2

Course Title	Advanced Calculus and Trigonometry
Course Code	23U2CRMAT02
Semester	2
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Text Books:

1) Calculus by Howard Anton, Irl Bivens, Stephens Davis. (10^{th} Edition), 2010, Wiley India Pvt Ltd.

2) Differential Calculus by Shanti Narayanan and P.K.Mittal.

3) Plane Trigonometry- Vol II, S. L Loney.

Course Objectives:

The objectives of the course are to

1) familiarise the students with the concept of higher order derivatives and their applications.
2) Introduce parametric equations of curves and their applications.
3) introduces multiple integrals and their application to area and volume problems.
4) Familiarise results in trigonometry.

Course outcomes

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Compute higher order derivative by applying Leibnitz theorem	PO1/PSO2	A	PK	8	0
CO2	Determine the Taylor and Maclaurin series expansions of given functions	PO1/PSO2	AP	P	6	0
CO3	Find curvature and related parameters of a given curve or curves	PO1/PSO2	U	P	6	0
CO4	Calculate the arc length of a given curve and area enclosed by curves	PO1/PSO2	AP	P	16	0
CO5	Find the area and volume using multiple integrals	PO1/PSO2	U	P	18	0
CO6	Understand the concepts of Trigonometric functions, their properties and summation of trigonometric series	PO1/PSO2	U	C	18	0
	Total Number of Hours				72	0

Bridge Course

The derivative function, Techniques of differentiation, Derivatives of standard functions, indefinite integral, definite integral, Fundamental theorem of Calculus, techniques of integration.

(Sections 2.1-2.7, 4.1-4.6 of the text 1)

Module I (20 hrs)

Successive differentiation, Leibniz Theorem, nth derivative of Functions, Taylor's and Maclaurins series (Proofs Excluded), Expansions of standard functions (e^x,sin x, cos x, $(1+x)^n$

log (1+x), sinhx, coshx, tan^{-1}(x), sin^{-1}(x), curvature, evolute, involute, asymptotes and envelopes.

(Relevant topics of sections 5.1-5.5, 6.1-6.2,14.1,14.3,14.5,14.7,15.1-15.3 of text 2)

Module II (16 hrs)

Parametric Equations; Tangent Lines and Arc Length for parametric curves, Polar Coordinates, Tangent Lines, Arc Length and area for polar curves.

(Sections 10.1-10.3 of text 1)

Module III (18 hrs)

Double integrals, double integrals over nonrectangular regions, double integrals in polar coordinates, surface area; Parametric surfaces, Triple integrals, Triple integrals in cylindrical and Spherical Coordinates.

(Sections 14.1-14.6 of Text 1)

Module IV (18 hrs)

Circular and Hyperbolic functions of complex variables, Separation of functions of complex

variables into real and imaginary parts, Factorization of x^n+1, x^n-1,

x^{2n}-2$x^n a^n cos(n\theta)$+a^{2n}.and summation of infinite series by C+iS method.

(Relevant sections of Text 3- Chapter V,VI,VIII,IX)

References:

1) Thomas Calculus by Maurice Weir, Joel Hass, Frank R Giordano (14th edition), 2008, Pearson Education

2) Calculus: (Vol 1) One Variable Calculus with an introduction to Linear Algebra by Tom M Apostol (2nd Edition), 2016, Wiley Student Edition.

3) Advanced Calculus, Schaum's outlines, by Robert C Wrede and Murray Spiegel. (2nd Edition), 2005, Tata McGraw-Hill.

4) Calculus and Its Applications by Larry J Goldstein, David C Lay, David I Schneider and Nakhle H Asmar (12th Edition), 2010, Pearson Education.

5) Calculus Early Transcendentals, by James Stewart (5th Edition), 2007, Thomson Learning.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	2	2	1	5
II	4	2	0	6
III	4	2	2	8
IV	2	2	1	5
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course -3

Course Title	Vector Calculus, Theory of Equations and Matrices
Course Code	23U3CRMAT03
Semester	3
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

The course objectives are

1) To introduce the applications of vector calculus to real world problems.
2) To enable the student to find the number, location and roots of real polynomial equations up to fourth order
3) To study matrix theory and its application to solution of systems of linear equations.
4) To study the applications of Cayley Hamilton theorem.

Course Outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Find the gradient of a Scalar Field, the Divergence and Curl of a Vector Point Function, and the directional derivative	PO1/PSO2	A	PK	20	0
CO2	Understand the applications of vector integration	PO1/PSO2	AP	P	25	0

CO3	Determine the number of roots of polynomial equation of order at most four	PO1/PSO2	U	P	23	0
CO4	Compute inverses and powers of matrices using Cayley Hamilton theorem	PO1/PSO2	AP	P	22	0
	Total Number of Hours				90	0

Text Book: Engineering Mathematics, N.P. Bali, Manish Goyal

Module I (20 hrs)

Scalar and Vector Fields, Gradient of a Scalar Field, Geometrical Interpretation of Gradient, Directional Derivative, Properties of Gradient, Divergence of a Vector Point Function, Curl of a Vector Point Function, Physical Interpretation of Divergence, Physical Interpretation of Curl, Properties of Divergence and Curl, Repeated Operations by ∇ .

(Relevant Sections 8.10-8.20 of Text 1)

Module II (25 hrs)

Integration of Vector Functions, Line Integrals, Circulation, Work Done by a Force, Surface Integrals, Volume Integrals, Divergence Theorem of Gauss (Relation between Surface and Volume Integrals), Green's Theorem in the Plane, Stoke's Theorem (Relation between Line and Surface Integrals).(All theorems without proof).

(Sections 8.21-8.29 of Text 1)

Module III (23 hrs)

Zero of a Polynomial, Division Algorithm, Polynomial Equation, Root of an Equation, Synthetic Division, Fundamental Theorem of Algebra, Multiplication of Roots, Diminishing and increasing the roots, Removal of Terms, Reciprocal Equations, Sum of the Integral Powers of the Roots and Symmetric Functions, Symmetric Functions of the Roots, Descarte's Rule of Signs, Cardan's Method, Descarte's Method, Ferrari's Solution of the Biquadratic.

(Sections 2.5-2.18 and 2.20-2.21 of Text 1)

Module IV (22 hrs)

Elementary Transformations, Elementary Matrices, Inverse of Matrix by E-operations (Gauss-Jordan method), Rank of a Matrix, Solution of a System of Linear Equations, If A is a Non-Singular Matrix, then the Matrix Equation AX = B has a Unique Solution, Vectors, Linear dependence and Linear Independence of Vectors, Linear Transformations, Orthogonal Transformation, Complex Matrices, Characteristic Equation, Eigen Vectors, Cayley Hamilton Theorem

(Sections 3.34-3.35 and 3.37-3.48 of Text 1)

References

1) Calculus, by Howard Anton, Irl Bivens, Stephen Davis. (10^{th} Edition),

Wiley Student Edition.

2) Thomas Calculus by Maurice Weir, Joel Hass, Frank R Giordano.(14^{th} edition), 2008, Pearson Education

3) Advanced Engineering Mathematics by Erwin Kreyzsig, Ninth Edition, Wiley, India

4) Higher Algebra by H.S. Hall and S.R. Knight, Surjit Publications, Delhi.

5) Higher Algebra by S. Bernard and J.M. Child, AITBS Publishers, India, 2009

6) Basic Linear Algebra, S.Blyth and E.F. Robertson, Springer, Second Edition, 2002

7) Matrices, Schaum's Outline Series, Tata McGraw Hill Publications

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course 4

Course Title	Fourier series, Laplace transforms, Numerical Methods and Number Theory
Course Code	23U4CRMAT04
Semester	4
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

The objectives of the course are

1) Introduce Fourier series
2) Introduce Laplace transforms
3) familiarize numerical methods of solving polynomial equations and basic number theory.

Course Outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand periodic functions and Fourier series	PO1/PSO2	R	F	5	0
CO2	Understand Fourier half range series	PO1/PSO2	U	F, C	8	0

CO3	Understand Laplace and inverse Laplace transforms	PO1/PSO2	U	F, C	7	0
CO4	Solve differential equations using Laplace transforms	PO1/PSO2	U	P	25	0
CO5	Solve polynomial equations using numerical methods	PO1/PSO1	AP	P, C	25	0
CO6	Understand Congruences, Fermat's Theorem, Eulers theorem and Wilson's Theorem	PO1/PSO2	U	C	20	0
	Total Number of Hours				90	0

Text Book:

1) A textbook of Engineering Mathematics, by N P Bali, Manish Goyal Lakshmi publications, 8th edition

2) David M Burton - Elementary Number Theory, 7th Edition, McGraw Hill

Education (India) Private Ltd.

3) Introductory Methods of Numerical Analysis, by S.S.Sastry, Fourth Edition, PHI

Module I (25 hrs)

Periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, Change of interval, Half range series

Sections 10.1 to 10.7 of text 1

Module II (25 hrs)

Definitions, Properties, Inverse Laplace transforms, Convolution theorem, Application to differential equation

(Sections 18.1 to 18.12 of text 1)

Module III (20 hrs)

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

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

Module IV (20 hrs)

Basic properties of congruence, Fermat's theorem, Wilson's theorem, Euler's phi function.

(Text 2: Chapter 4: section 4.2, Chapter 5: sections 5.2, 5.3 and Chapter 7: section 7.2.)

References

1) Advanced Engineering Mathematics, Erwin Kreyszig, 8th edition, Wiley India.

2) A Friendly Introduction to Number Theory by David Silverman, Pearson Education.

3) Numerical Methods for Scientists and Engineers by K. Sankara Rao

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	4	2	1	7
III	2	2	1	5
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course -5

Course Title	Real Analysis - I
Course Code	23U5CRMAT05
Semester	5
Credits	4
Contact Hours per week	6
Contact hours per semester.	108

Text Book

Introduction to Real Analysis – Robert G Bartle and Donald R Sherbert (3rd Edition) John Wiley & Sons, Inc. 2007

Course Objectives

The objectives of the course include the following:

1) To study elementary properties of real numbers.
2) To introduce sequences and series and their properties.
3) To introduce the limit of a function.

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand the order and completeness property of R	PO1/PSO2	U	F	30	0
CO2	Analyse sequences and their convergences	PO1/PSO2	A	F,C	30	0
CO3	Analyse series and test their convergence	PO1/PSO2	AP	F,C	24	0

CO4	Explain the concept of limit of a function	PO1/PSO2	U	F,P	24	0
	Total Number of Hours				108	0

Module I (**30 hrs)**

Finite and Infinite Sets, The Algebraic and Order Properties of R, Absolute Value and Real Line, The Completeness Property of R, Applications of the Supremum Property, Intervals.

Chapter 1: Section 1.3 and Chapter 2 : Sections 2.1, 2.2,2.3,2.4,2.5

Module II (**30 hrs**)

Sequences and their Limits, Limit Theorems, Monotone Sequences, Subsequence and the Bolzano-Weierstrass Theorem, The Cauchy Criterion, Properly Divergent Sequences.

Chapter 3: Sections 3.1,3.2,3.3,3.4, 3.5,3.6

Module III (24 hrs)

Introduction to Series, Absolute Convergence, Tests for Absolute convergence, Tests for non absolute Convergence

Chapter 3: Section 3.7, Chapter 9 : Sections 9.1,9.2,9.3

Module IV (**24 hrs)**

Limits of Functions, Limit Theorems, Some Extensions of the Limit Concept.

Chapter 4: Sections 4.1,4.2,4.3

References:

1. Richard R Goldberg - Methods of real Analysis, 3rd edition , Oxford and IBM Publishing Company (1964)

2. Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)

3. Elias Zako - Mathematical Analysis Vol 1, Overseas Press, New Delhi (2006)

4. J.M Howie - Real Analysis, Springer 2007.

5. K.A Ross- Elementary - Real Analysis, Springer, Indian Reprints.

6. S.C Malik, Savitha Arora - Mathematical Analysis, Revised Second Edition

Question Paper Pattern

Module 1	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	2	4	18
Maximum Marks	20	25	30	75

Core Course – 6

Course Title	Differential Equations
Course Code	23U5CRMAT06
Semester	5
Credits	4
Contact Hours per week	6
Contact hours per semester.	108

Text Books:

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

Course Objectives

The objective of the course is to

1) equip the student with the methods of solution of differential equations, both ordinary and partial.
2) introduce power series solution.
3) introduce simultaneous differential equations and hence solve first order pde.

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand the method for solving ordinary differential equations	PO1/PSO2	U	F	25	0
CO2	Understand linear differential equations and its solutions	PO1/PSO2	U	F,C	30	0
CO3	Compute the solutions of second order linear differential equations using power series method	PO1/PSO2	AP	F,C	35	0
CO4	Understand partial differential equations and method of solving the same	PO1/PSO2	U	F,P	18	0
	Total Number of Hours				108	0

Module I (25 hrs)

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

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

Module II (30 hrs)

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

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

Module III (35hrs)

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

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

Module IV (18 hrs)

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

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

(Chapter 1 , section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text 2)

References

1) A.H.Siddiqi & P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)
2) George. F. Simmons – Differential equation with applications and historical notes (Tata McGraw Hill)
3) W.E. Boyce & R.C. Diprima - Elementary Differential Equations and boundary value Problems,(Wiley India)
4) S. Balachandra Rao & H. Ranuradha – Differential Equation with Applications and Programs (Universities Press)
5) R. K. Ghosh & K. C. Maity - An Introduction to Differential Equations (New Central Books Agency)
6) B. K. Dutta – Introduction to Partial Differential Equations (New Central Books) .
7) Murray –Differential Equations. Macmillian
8) E.A. Coddington - An Introduction to Ordinary Differential Equation, PHI.
9) Sankara Rao - Introduction to Partial Differential Equation, 2nd edition, PHI.
10) Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

Question Paper Pattern

Module 1	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course – 7

Course Title	Algebra
Course Code	23U5CRMAT07
Semester	5
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Book:

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

Course Objectives:

The course aims at

1) introducing the concept of groups and related concepts including subgroups, cyclic groups, abelian and non abelian groups, permutation groups, Lagrange's Theorem, Normal subgroups and Factor groups and homomorphisms and simple groups.
2) introduce the concepts of ring, ring with unity, commutative ring, integral domain, division ring and field.

Course Outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand concepts of binary operations and groups	PO1/PSO2	U	F	25	0
CO2	Understand the concepts of subgroups, cyclic group	PO1/PSO2	U	F,C	15	0

CO3	Understand Lagrange's theorem and its applications	PO1/PSO2	U	F,C	10	0
CO4	Understand the concepts of homomorphism and factor groups	PO1/PSO2	U	F,P	10	0
CO5	Compute factor groups	PO1/PSO2	AP	P,C	10	0
CO6	Understand the concepts of Rings, Fields, Integral Domains	PO1/PSO2	U	C	20	0
	Total Number of Hours				90	0

Bridge Course

Basic Logic (Negation, Converse, Counter positive of Statements, Methods of Proof), Sets and relations, Functions, Types of Functions.

Module I (25 hrs)

Binary Operations, Isomorphic Binary Structures, Groups, Subgroups and Cyclic Groups.

(Sections 2-6 of the text)

Module II (25 hrs)

Groups of Permutations, Orbits, Cycles, and the Alternating Groups, Cosets and the Theorem of Lagrange, Direct Products

(Sections 8-10 and Section 11.1-11.11 of the Text)

Module III (20 hrs)

Homomorphisms, Factor Groups, Factor Group Computations and Simple Groups.

(Sections 13-15 of the Text)

Module IV (20 hrs)

Rings and Fields, Integral Domains, Fermat's and Euler's Theorems, Homomorphisms and Factor Rings, (Proofs of Theorems 26.3,26.7,26.9 and 26.17 are to be excluded) (Sections 18-20, 26).

References

1) Topics in Algebra by I.N. Herstein, Wiley Student Edition.

2) Contemporary Abstract Algebra by Joseph A Gallian, Narosa Publishing House.

3) Algebra by Michael Artin, PHI

4) Abstract Algebra by David S Dummit and Richard M Foote

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course -8

Course Title	Human Rights and Mathematics for Environmental Studies
Course Code	23U5CRMAT08
Semester	5
Credits	4
Contact Hours per week	4
Contact hours per semester.	72

Course Objectives:

The course objective is to

1) Understand various environmental issues.
2) Understand Fibonacci numbers and its applications in nature.
3) Understand the concepts of human rights.

Course outcomes

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand the nature of environmental issues	PO4/PSO4	U	F	2	0
CO2	Understand the different types of natural resources and ecosystems	PO4/PSO4	U	F,C	16	0
CO3	Understand the various environmental pollutions and social issues.	PO4/PSO4	U	F,C	26	0

CO4	Understand the patterns in the nature through mathematics	PO4/PSO4	U	F,P	20	0
CO5	Understand the concepts of Human Rights	PO4/PSO4	U	P,C	8	0
	Total Number of Hours				72	0

Text Book:

1) Fibonacci and Lucas numbers with applications, by Thomas Koshy, John Wiley

& Sons, Inc (2001).

2) Text Book of Environmental Studies for undergraduate Courses. By Bharucha Erach

University Press, IInd Edition 2013 (TB)

3) Elementary differential equations and Boundary value problems, 9th edition, William E Boyce, Richard C. Diprima

Module I (24 hrs)

Definition, scope and importance

Need for public awareness.

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

a) **Forest resources**: Use and over-exploitation, deforestation, case studies.

Timber extraction, mining, dams and their effects on forest and tribal people.

b) **Water resources**: Use and over-utilization of surface and ground water,

floods, drought, conflicts over water, dams-benefits and problems.

c) **Mineral resources**: Use and exploitation, environmental effects of extracting

and using mineral resources, case studies.

d) **Food resources**: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) **Energy resources**: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.

f) **Land resources**: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

Role of individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumer decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids

Introduction, types, characteristic features, structure and function of the given ecosystem: -

Forest ecosystem

(Relevant topics from Text 2)

Module II (20 hrs)

Modelling with first order equations, Differences between linear and nonlinear equations, Autonomous equations and population dynamics.

(Relevant topics from sections 2.3-2.5 of text)

Module III (10 hrs)

The rabbit problem, Fibonacci numbers, recursive definition, Lucas numbers, Fibonacci and Lucas numbers. Fibonacci numbers in nature: Fibonacci and the earth, Fibonacci and flowers, Fibonacci and sunflower, Fibonacci, pinecones, artichokes and pineapples, Fibonacci and bees, Fibonacci and subsets, Fibonacci and sewage treatment, Fibonacci and atoms, Fibonacci and reflections, Fibonacci, paraffins and cycloparaffins, Fibonacci and music, Fibonacci and compositions with 1’s

and 2's.

Text 1: Chapters 2 & 3 (excluding Fibonacci and poetry, Fibonacci and electrical networks)

Module IV (10 hrs)

The Golden ratio, mean proportional , a geometric interpretation , ruler and compass construction ,Euler construction, generation by Newton's method. The golden ratio revisited, the golden ratio and human body, golden ratio by origami, differential equations, Gattei's discovery of golden ratio, centroids of circles.

Text 1 : Chapters 20, 21

Module V (8 hrs)

Unit1-Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2 Human Rights and United Nations – contributions, main human rights related organs - UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Internal: Field study

- Visit to a local area to document environmental grassland/ hill /mountain
- Visit a local polluted site – Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds etc
- Study of simple ecosystem-pond, river, hill slopes, etc

(Field work Equal to 5 lecture hours)

References

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

2. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)

3. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)

4. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)

5. Down to Earth, Centre for Science and Environment (Ref)

6. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)

7. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)

8. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)

9. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)

10. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)

11. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)

12. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)

13. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)

14. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)

15. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)

16. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication

(Ref)

17. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia,

USA 499p (Ref)

18. (M) Magazine (R) Reference (TB) Textbook

Human Rights

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.

2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla:

Indian Institute of Advanced Studies, 1998)

3. Law Relating to Human Rights, Asia Law House,2001.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	2	1	1	4
II	2	1	1	4
III	3	3	1	7
IV	3	2	1	6
V	2	1	0	3
Total No of Questions	12	8	4	24
Total Marks	20	25	30	75

Core Course-9

Course Title	Real Analysis - 2
Course Code	23U6CRMAT09
Semester	6
Credits	4
Contact Hours per week	6
Contact hours per semester.	108

Text Book:

Introduction to Real Analysis – Robert G Bartle and Donald R Sherbert (3rd Edition) John Wiley & Sons, Inc.

Course Objectives

The objectives of the course include the following:

1) To introduce continuous functions and to study their properties.
2) To introduce derivable functions.
3) To introduce Riemann integration for evaluating the integrals of certain bounded functions on finite closed intervals.
4) To study uniform convergence of a sequence and a series of functions.

Course Outcomes

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand the basic theorems relating continuity	PO1/PSO2	U	F	20	0
CO2	Understand the concept of differentiation and basic theorems	PO1/PSO2	U	F,C	25	0
CO3	Study the concept of Riemann integration	PO1/PSO2	U	F,C	25	0
CO4	Understand the concepts of pointwise and uniform convergence	PO4/PSO4	U	F,P	20	0
	Total Number of Hours				90	0

Module I (**30 hrs)**

Continuous Functions, Combinations of Continuous Functions, Continuous Functions on Intervals, Uniform continuity, Monotone and Inverse Functions.

Chapter 5: Sections 5.1,5.2,5.3,5.4,5.6

Module II (30 hrs)

The Derivative, The Mean Value Theorem, L' Hospital Rules, Taylor's Theorem

Chapter 6: Sections 6.1,6.2,6.3,6.4

Module III (24 hrs)

The Riemann Integral, Riemann Integrable Functions, The Fundamental Theorem

Chapter 7: Sections 7.1,7.2,7.3

Module IV (24 hrs)

Pointwise and Uniform Convergence, Interchange of Limits, Series of Functions.

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

References:

1. Richard R Goldberg - Methods of real analysis, 3rd edition , Oxford and IBM Publishing Company (1964)

2. Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)

3. Elias Zako - Mathematical Analysis Vol 1, Overseas Press, New Delhi (2006)

4. J.M Howie - Real Analysis, Springer 2007.

5. K.A Ross- Elementary - Real Analysis, Springer, Indian Reprints.

6. S.C Malik, Savitha Arora - Mathematical Analysis, Revised Second Edition 3

Question Paper Pattern

Module	Part-A (2 marks)	Part – B (5 marks)	Part – C (10 marks)	Total
1	3	3	1	7
2	3	2	1	6
3	4	1	1	6
4	2	2	1	5
No. of Questions	12	8	4	24
Maximum marks	20	25	30	75

Core Course -10

Course Title	Complex Analysis
Course Code	23U6CRMAT10
Semester	6
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text book:

Complex variables and applications by James Ward Brown & Ruel V. Churchill

(8^{th} edition)

Course Objectives:

The objectives of the course include

1) familiarising the student with the theory of functions of one complex variable, differentiability
2) understand analyticity of functions, complex integration and related topics

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand theorems on limit and continuity of functions of one complex variable	PO1/PSO2	U	F	32	0
CO2	Understand the significance of the Cauchy Riemann equations.	PO1/PSO2	U	F,C	15	0
CO3	Understand the sufficient conditions for differentiability	PO1/PSO2	U	F,C	5	0
CO4	Understand the relationship between analytic and harmonic functions.	PO1/PSO2	U	F,P	5	0
CO5	Understand the concepts of convergence of complex sequences and series	PO1/PSO2	U	F,P	15	0
CO6	Understand residue calculus and its applications	PO1/PSO2	U	F,P	18	0
	Total Number of Hours				90	0

Bridge Course (4 hrs)

A quick review on Complex numbers and its properties, vectors and moduli, complex conjugates, exponential forms, arguments and its properties, roots of complex numbers, and regions in complex plane.

(No questions shall be asked from this section.)

Module I (28 hrs)

Functions of a complex variable, limits, theorems on limits, continuity, derivatives,

differentiation formulas, Cauchy-Riemann equation, sufficient condition for differentiability, Analytic functions, examples, harmonic functions. Elementary functions, the 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 to 26); Chapter 3 (Sections 29, 30, 33 to 36)

Module II (25 hrs)

Derivatives of functions, definite integrals of functions, contours, contour integrals, some examples, upper bounds for moduli of contour integrals, antiderivatives, Cauchy-Goursat theorem (without proof), simply and multiply connected domains, Cauchy's integral formula, an extension of Cauchy's integral formula, Liouville's theorem and fundamental theorem of algebra, maximum modulus principle.

Chapter 4 (Sections 37 to 41, 43, 44, 46, 48 to 54);

Chapter 5 (Sections 55 to 60 and 62).

Module III (15 hrs)

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

Chapter 5 (Sections 55 to 60 and 62)

Module IV(18 hrs)

Isolated singular points, residues, Cauchy's residue theorem, three types of isolated singular points, residues at poles, examples. Applications of residues, evaluation of improper integrals, examples.

Chapter 6 (Sections 68 to 70 and 72 to 74); Chapter 7 (Section 78)

References

1) Complex Analysis- An introduction to the theory of Analytic of one Complex Variable by Lars V Ahlfors (4^{th} Edition), Mc Graw Hill

2) Complex Analysis by J.M.Howie, Springer

3) Complex Analysis with Applications by A David Wunsch, Pearson

4) Complex Variables, Theory and Applications, by Kasana, 2nd Edition

5) Foundations of Complex Analysis by S Ponnusamy

6) Complex Analysis by V Karunakaran

7) The Elements of Complex Analysis by B Chaudhary

8) Complex Variables – A physical approach with applications and MATLAB by Steven G Krantz, Chapman and Hall/CRC(2007)

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course -11

Course Title	Linear Algebra
Course Code	23U6CRMAT11
Semester	6
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Books :

Linear Algebra A Geometric approach, S. Kumaresan, PHI Learning

Course Objectives:

The objectives of the course are

1) to introduce the concept of vector space, linear independence and row space.

2) to introduce the concept of basis and dimension.

Course Outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand the concepts of vector space, subspace, linear independence.	PO1/PSO2	U	F	25	0
CO2	Understand the concepts of basis and dimension	PO1/PSO2	U	F,C	25	0
CO3	Understand the concepts of linear transformation and matrix representation	PO1/PSO2	U	F,C	20	0

CO4	Understand the concepts of kernel and image	PO1/PSO2	U	F,P	20	0
	Total Number of Hours				90	0

Module I (25 hrs)

Vector spaces: Vectors, Subspace, Linear Independence

(Relevant topics in Chapter – 2 Sections 2.1, 2.2 of text 1)

Module II (25 hrs)

Basis and Dimension of a vector space

(Relevant topics in Chapter –2 Sections 2.3 of text 1)

Module III (20 hrs)

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

(Relevant topics in Chapter-4 Sections 4.1 (omit the proof of Theorem 4.1.4), 4.2

Module IV (20 hrs)

Kernel and image of Linear transformations, Some special linear transformations

(Relevant topics in chapter 4, sections 4.3, 4.6)

References

1)Linear Algebra Done Right, Sheldon Axler, Springer, 2015.

2) Linear Algebra, A Geometric Approach by S Kumaresan, PHI Learning Pvt.Ltd,

3) Linear Algebra, David C Lay, Pearson Education.

4) Introduction to Graph Theory by Douglas B West, Pearson Education.

5) A Text Book of Graph Theory by R. Balakrishnan and K. Ranganathan, Springer,2013.

6) Graph Theory by Frank Harary

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Core Course -12

Course Title	Graph Theory and Metric Spaces
Course Code	23U6CRMAT12
Semester	6
Credits	4
Contact Hours per week	5
Contact hours per semester	90

Text books:

1), A text book of Engineering Mathematics, by N.P Bali, Manish Goyal Lakshmi publications, Eighth edition

2) An introduction to Topology and Modern Analysis by G.F. Simmons, Tata McGraw Hill Publishers

Course Objectives:

The objectives of the course include

1) introducing the concepts of Graph theory.
2) introducing the concept of metric spaces

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand the concepts of different types of graphs.	PO1/PSO2	AP	F,P	25	0
CO2	Understand the concept of matching in a graph, the Marriage problem and various assignment problems	PO1/PSO2	AP	F,P	25	0

CO3	Understand the concepts of metric spaces, subspaces, open and closed sets	PO1/PSO2	U	F,C	15	0
CO4	Understand the concept of convergence, completeness and continuity in a metric space	PO1/PSO2	U	F,C	20	0
	Total Number of Hours				90	0

Module I (25 hrs)

An introduction to graph. Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, the matrix representation of graphs, Trees. Definitions and Simple properties, Bridges, Spanning trees. Cut vertices and Connectivity.

Text 1: Chapter 1 (Sections 1.1 to 1.7) Text 1: Chapter 2 (Sections 2.1, 2.2 ,2.3& 2.6)

Module II (25 hrs)

Euler's Tours, the Chinese postman problem. Hamiltonian graphs & the travelling salesman problem, Matching and augmenting paths, Hall's Marriage theorem (Statement only), Personnel assignment problem, the optimal assignment problem.

Chapter 3 Sections 3.1 (algorithm deleted), 3.2 (algorithm deleted), 3.3, and 3.4 (algorithm deleted), Chapter 4.1, 4.2, 4.3(Algorithm deleted) 4.4(Algorithm deleted).

Module III (20 hrs)

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

(Chapters: - 2, Sections 9, 10,11 of text 2)

Module IV (20 hrs)

Convergence, Completeness, Continuous Mapping (Baire's Theorem included)

(Chapter: -2, Sections 12, 13)

References

1) Advanced Engineering Mathematics by Michael D Greenberg, Pearson Education, 2002

2) Advanced Engineering Mathematics by Erwin Kreyszig, Eighth edition, Wiley, India.

3) Topology of Metric Spaces, S Kumaresan, Narosa Publishing House, Second Edition, 2011

4) Topology, by James R Munkres, Second Edition, 2017, Pearson Education.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

4. **SYLLABUS OF OPEN COURSE**

Course Title	Applicable Mathematics
Course Code	23U5OCMAT
Semester	5
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Reference – Concepts of Arithmetic, by M. Tyra, & K. Kundan

BSC Publishing Company Pvt.Ltd, Delhi

Course Objectives

The objectives of this course include

1) preparing students of all streams, particularly those with arts and commerce back ground with the basics of mathematics required for their higher studies
2) preparing students of all streams, particularly those with arts and commerce back ground to approach competitive examinations.
3) Detailed explanation and short cut method for solving problems are introduced to students, so that they can acquire better understanding of concepts and problem-solving skill.

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand the concepts of quadratic equations, Logarithm, combinatorics	PO1/PSO2	U	F,P	18	0
CO2	Understand the concepts of probability and differential calculus	PO1/PSO2	U	F,P	18	0

CO3	Understand the concepts of LCM, HCF, Fractions, Ratio and Proportion and Percentage	PO1/PSO2	U	F,P	18	0
CO4	Understand the concept of simple interest, compound interest, and time and work and elementary algebra	PO1/PSO2	U	F,C	18	0
	Total Number of Hours				72	0

Module I (18 hrs)

Types of numbers, Quadratic equations (Solution of quadratic equations with real roots only), Logarithms – All rules without proof, Multiplication and division of numbers, Evaluating expressions of the form $x^{p/q}$, x any real number, p & q are integers, Permutations and combinations – simple applications, Trigonometry introduction, Values of trigonometric ratios of 0^0, 30^0, 45^0, 60^0& 90^0, Heights and distances – Simple cases - (application of sin x, cos x, tan x, and their reciprocals only). Two dimensional geometry- Introduction, plotting points and drawing graph of the lines of the form ax + by + c = 0.

Module II (18 hrs)

Probability – Introduction – Sample spaces and events, Simple examples like tossing coin , tossing die etc.., Differential Calculus - Differentiation – Standard results (derivatives) without proof, Product rule, Quotient rule and function of function rule), Integral calculus (Integration simple cases, with and without limits)

Module III (18 hrs)

HCF and LCM of numbers, Fractions, Squares and square roots, cube and cube roots, simplifications, Ratio and Proportion, Percentage, Profit and loss, Simple average (No Weighed average)

(Sections – 2, 3, 5, 6, 7, 9, 10, 11, 13)

Module IV (18 hrs)

Simple interest, Compound interest, Time and work, Work and wages, (Exclude Pipes and Systems from the core reference), Time and distance, Elementary mensuration – Area and perimeter of polygons, Elementary Algebra, (Simplifications of algebraic expressions)

(Sections - 14, 15, 17, 18, 21, 22, 23)

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

5. SYLLABUS FOR MATHEMATICS ELECTIVE COURSES

Elective Course -1

Course Title	Operations Research
Course Code	23U6CRMAT08
Semester	6
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Text Book

Operations Research-Theory and Applications , by J.K Sharma Macmillan Publishers, India Ltd.

Course Objectives:

The course objectives are

1) To understand and solve linear programming problems.
2) To analyze assignment and transportation problems.
3) To understand the concept of Game theory.

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Translate the real world problems in to corresponding LPP	PO1/PSO4	U	F,P	20	0
CO2	Understand the concepts of duality in LPP	PO1/PSO4	U	F,P	12	0

CO3	Understand the concepts of transportation and assignment problem	PO1/PSO4	U	F,P	22	0
CO4	Understand the concept of game theory	PO1/PSO4	U	F,C	18	0
	Total Number of Hours				72	0

Module I (20 hrs)

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

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

Module II (12 hrs)

Introduction, Formulation of Dual LPP, standard results on duality, Advantages of

Duality, Theorems of duality with proof.

Chapter 5: Sections: 5.1 to 5.3, 5.5 with appendix.

Module III (22 hrs)

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

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

Module IV (18 Hrs)

Introduction, Two-person zero sum games, pure strategic (Minimax and Maximin principles), Games with saddle point, mixed strategies, Games without saddle point, The rules of dominance,

solution methods: Games without saddle point (Arithmetic method, Matrix method, Graphical method and Linear programming method)

Chapter 12: Section 12.1 to 12.6

References

1) Operations Research by Ravindran, Philips and Solberg, Wiley India

2) Optimization methods, by K.V.Mital, C.Mohan,New Age International Publishers.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	5	3	1	9
II	1	2	-	3
III	4	2	2	8
IV	2	1	1	4
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Elective Course – 2

Course Title	Basic Python Programming and Typesetting in LaTeX
Course Code	23U6CRMAT14
Semester	6
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Course objectives

This course objectives include

1) Understand computer programming language using Python and document preparation using the LaTeX typesetting program.
2) understand fundamentals of this OS.

Course outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand the concepts of python programming	PO1/PSO4	U	F,P	16	0
CO2	Solve mathematical problems using python programming	PO1/PSO4	AP	F,P	20	0
CO3	Construct a basic document using LaTex	PO1/PSO4	U	F,P	16	0

CO4	Construct a document including figures and tables using LaTex	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Text Books

1 . The online Wiki book “Non-Programmer's Tutorial for Python 3” (A free PDF

book from the URL https://en.wikibooks.org/wiki/Non-

Programmer's_Tutorial_for_Python_3)

2. LATEX Tutorials : A PREMIER by Indian TEX Users Group, Edited by

E. Krishnan, 2003. A free PDF document from the URL

https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf

Module I (16 hrs)

Introduction of Python, its installation, IDLE and file name. Output function, Arithmetic Operators, Input and variables, assignment statement, simple string operations, while loops, if statement, relational operators, For loops.

Text 1: Chapters 2, 3, 4, 5, 6 and 11

Module II (20 hrs)

Defining functions, Variables in functions, Advanced functions, Recursion, Lists, More features of lists, More on lists, Revenge of the strings, Slicing of strings, File input or output.

Text 1: Chapters 8, 9, 10, 15, 16 and 17.

Module III (16 hrs)

The Basics: What is LATEX, Simple typesetting, Fonts, Type size. The Document: Document class, page style, page numbering, formatting lengths, parts of a document, dividing the document.

Bibliography: Introduction. Table of Contents: Table of Contents, Index, Glossary. Displayed Text: Borrowed words, poetry in typesetting, making lists. Rows and Columns: Tables.

Text 2 : Tutorial I (Sections I.1 to I.4), Tutorial II (Sections II.1 to II.7),Tutorial III (Section III.1) and Tutorial V (Sections V.1 to V.3),Tutorial VI (Sections VI.1 to VI.3) , Tutorial VII (Section VII. 2 [deleting VII.2.1 to VII.2.6])

Module IV (20 hrs)

Typesetting Mathematics: The basics, custom commands, more on mathematics, mathematics miscellany, And that is not all, symbols. Typesetting Theorems: Theorems in LaTeX **,** designer theorems - the amsthm package, Housekeeping. Floats : creating floating figures,

Cross References in LaTeX: Why cross references? Let LaTeX do it.

Text 2 :- Tutorial VIII (Sections VIII.1 to VIII.7 [deleting VIII.5 and VIII.6])

Tutorial IX ([deleting IX.2.3]), Tutorial XI (Section XI.1.1 only), and Tutorial XII (Section XII.1 and XII.2)

Being a computer programming course, there will be a Theory Part and a Practical Part. The total hours for the course are 72 hrs out of which 54 hrs for theory and 18 hrs for practical session. Sample programs and exercise questions given in the prescribed text should be practiced in the computer lab. The student has to maintain an observation note book and a practical record. The End semester exam is theory examination, but Practical examination should be conducted internally and this should be considered for internal mark.

References:

1) Dive Into Python by Mark Pilgrim, Free to download from the URLhttp://www.diveintopython.net/
2) The free to download book “Formatting inform action: A beginner’s introduction to typesetting with LaTeX” by Peter Flynn. This can be downloaded free from the URL https://www.ctan.org/pkg/beginlatex
3) LATEX , a Document Preparation System by Leslie Lamport (second edition, Addison Wesley, 1994).

4) The Not So Short Introduction to LaTeX2e by Tobias Oetiker Hubert Partl, Irene Hyna and Elisabeth Schlegl. Free to download from https://www.ctan.org/pkg/lshort-english

Question Paper Pattern

Module	Part A (2 marks)	Part B (5 marks)	Part C (10 marks)	Total
I	2	2	1	5
II	3	2	1	6
III	3	2	1	6
IV	4	2	1	7
Total No. of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Elective Course – 3

Course Title	Numerical Analysis
Course Code	23U6CRMAT15
Semester	6
Credits	3
Contact Hours per week	4
Contact hours per semester	72

Course Objectives:

The objective of the course is to

1) Understand the numerical solutions of equations
2) Familiarise the concept of interpolation
3) Analyse the concept of DFT and IDFT

Course Outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Solve algebraic and transcendental equations using numerical methods	PO1/PSO4	AP	F,P	20	0
CO2	Understand the concepts of interpolation	PO1/PSO4	U	F,P	18	0
CO3	Understand the concepts of DFT and IDFT		U	F,P	14	0

		PO1/PSO4				
CO4	Compute derivatives and antiderivatives using numerical methods	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Use of Non Programmable Scientific Calculator is Permitted

Text Books :

1) S. S. Sastry - Introductory Methods of Numerical Analysis , PHI Learning

Private Limited Fifth Edition

2) Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition Wiley

New Delhi, 2015.

Module I (20 hrs)

Solution of Equations

(A quick review mathematical preliminary, errors, algebraic and transcendental equations) Bisection Method, Method of False Position, Iteration Method, Aitken's Δ process, Newton–Raphson Method, Generalised Newton's Method and Ramanujan's Method

Text 1: Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6)

Module II (18 hrs)

Interpolation

Errors in Polynomial Interpolation, Forward Differences, Backward Differences, Central Differences Symbolic Relations, Difference of a Polynomial and Newton's Formulae for Interpolation.

Text 1: Chapter 3 (Sections 3.1, 3.2, 3.3, 3.5 and 3.6)

Module III (14 hrs)

Fourier Approximations

Fourier series, Fourier transform, Discrete Fourier transform (DFT) and inverse Discrete Fourier transform (IDFT).

Text 2: Chapter 4 (Section 4.6: 4.6.1 and 4.6.2).

Module IV (20 hrs)

Numerical Differentiation and Integration

Introduction, numerical differentiation and errors in numerical differentiation. Numerical

Integration, Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Boole's and Weddle's Rules.

Text 1 : Chapter 6 (Sections 6.1, 6.2 : 6.2.1. Sections 6.4: 6.4.1, 6.4.2, 6.4.3 and 6.4.4)

References

1. Scarborough : Numerical Mathematical Analysis

2. Francis Shield (Schaum's Series) : Numerical Analysis

3. Hilderbrand : Introduction to Numerical Analysis

Question Paper Pattern

Module	Part A (2 marks)	Part B (5 marks)	Part C (10 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	2	1	6
Total No. of Questions	12	8	4	24
Total Marks	20	25	30	75

6. SYLLABUS OF COMPLEMENTARY COURSES IN MATHEMATICS (B.Sc PHYSICS/ CHEMISTRY)

Complementary Course I

Course Title	Calculus I
Course Code	23U1CPMAT01
Semester	1
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Course Objectives

The objective of the course is

1) To give a brief idea about the applications of Differentiation and integration.

2) To get an idea about partial differentiation, chain rule and optimization in multivariable functions.

3) To find the area and volume of regions in 2- and 3-dimensional space

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Apply Rolle's Theorem and Mean Value theorem to solve real world problems.	PO1/PSO2	A	PK	20	0
CO2	Determine whether a given function is increasing or decreasing.	PO1/PSO2	A	P	20	0
CO3	Apply the concepts of maxima and minima of a function to real world problems	PO1/PSO2	A	P	16	0
CO4	Compute the area and volume of solids using definite integrals	PO1/PSO2	A	P	16	0
	Total Number of Hours				72	0

Text Book

George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008

Module I (15 hrs)

Extreme values of functions, The Mean Value Theorem, Monotonic functions and the first derivative test. (Sections 4.1 - 4.3 of Text 1)

Module II (15 hrs)

Functions of several variables (Definition only), Partial derivatives, The Chain Rule, Extreme values and Saddle points, Lagrange multiplier Method

(Sections 14.3 - 14.4,14.7,14.8 of Text 1)

Module III (20 hrs)

Substitution and area between curves, Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution and the theorem of Pappus (excluding theorem of Pappus)

(Section 5.6, 6.1, 6.3, 6.5 of Text - 1)

Module IV (22 hrs)

Double Integrals, area of bounded region in plane only, Double Integrals in Polar form, Triple integrals in rectangular co-ordinates, Volume of a region in space

(Sections 15.1, 15.2, 15.3, 15.4 of Text – 1)

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Complementary Course – 2

Course Title	Calculus II and Numerical Analysis
Course Code	23U2CPMAT02
Semester	2
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Text Book: N.P Bali, Manish Goyal, A text book of Engineering Mathematics, Lakshmi publications, Eight edition

Course Objectives:

1) To introduce the applications of vector calculus to real world problems.

2) To introduce the method of finite differences and interpolation

3) To introduce numerical methods of solving polynomial equations

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Find the gradient of a Scalar Field, The Divergence of a Vector Point Function, and the directional derivative and curl	PO1/PSO2	A	PK	20	0
CO2	Understand the applications of vector integration, in particular those of the Green's theorem, Stoke's theorem and divergence theorem.	PO1/PSO2	A	P	20	0
CO3	Understand finite differences and interpolation techniques.	PO1/PSO2	A	P	14	0
CO4	Use numerical methods to solve polynomial equations.	PO1/PSO2	A	P	18	0
	Total Number of Hours				72	0

Module I (20 hrs)

Velocity and Acceleration, Scalar and vector fields, Gradient of a scalar field, Geometrical Interpretation of Gradient, Directional Derivative, Divergence and curl of a vector function and its physical interpretations. Properties of Divergence and curl Repeated operations by ∇

(Section 8.9 to 8.20 of text)

Module II (18 hrs)

Line integrals, Circulation, Work done, Surface integrals, volume integrals, Divergence theorem, Stoke's and Green's theorem

(Section 8.21 to 8.29 of text)

Module III (16 hrs)

Forward and backward operators, Shift operator, its properties, Newton Gregory Formula, Lagrange's formula, Gauss formula, Stirling formula, Laplace Formula, Newton's divided difference formula, Numerical integration and differentiation. Newton Cotes Method, Trapezoidal and Simpson's formula

(sections 22.1 to 22.11(d))

Module IV (18 hrs)

Graphical Method, Bisection method, Iteration method, Newton's method, Regula Falsi method, Horner's method, Graeffe root squaring method

Sections 22.16 to 22.16(g)

References

1) Advanced Engineering Mathematics, by Erwin Kreyszig, Wiley, India.

2) Numerical Analysis by S.S.Sastry, PHI

3) Numerical Methods for Scientists and Engineers by K. Sankara Rao**Question Paper Pattern**

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	4	2	1	6
4	2	2	1	6
Total No of Questions	12	8	4	24
Total Marks	20	25	30	75

Complementary Course – 3

Course Title	Differential Equations, Matrices and Trigonometry
Course Code	23U3CPMAT03
Semester	3
Credits	4
Contact Hours per week	5
Contact hours per semester	90

Text Books

1) A text book of Engineering Mathematics,by N.P Bali, Manish Goyal , Lakshmi publications, Eight edition

2) Plane Trigonometry by S. L Loney

Course Objectives:

The objectives of the course include

1) familiarizing the student with the techniques of solving first order ordinary differential equations, the origin of first order pde's and their solution.
2) introduce matrix theory and its application in solving systems of linear equations and applications of the Cayley Hamilton theorem.
3) Study basic trigonometry including summation of infinite series by the C+iS

Course Outcomes

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand the solution of first order ode's and the origin of first order pde's and their solution.	PO1/PSO4	AP	F,P	20	0
CO2	Understand different types of matrices and rank of a matrix and solving linear system of equations	PO1/PSO4	U	F,P	18	0
CO3	Find the eigen values and eigen vectors of a given matrix	PO1/PSO4	U	F,P	14	0
CO4	Understand trigonometric functions, their expansions and summation of infinite series using the C+iS method	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Module I (22 hrs)

Separable Equations and reducible to separable equations, Homogeneous Equations, Linear Differential equations, Bernoulli's equation, Exact Differential equations and integrating factors

(Sections 11.5 to 11.12 of text 1)

Module II (22 hrs)

Formation of partial differential equations, Solution by Direct integration, Lagrange's method,

(Sections 16.2 to 16.5 of text 1)

Module III (23 hrs)

Transpose of Matrices, Symmetric and skew symmetric matrices, Singular and non singular matrices. Elementary transformations, Inverse of a matrix, rank of a matrix, solution of system of linear equations, characteristic equation, Eigen values, Cayley Hamilton theorem

(Sections 3.19,3.20,3.26,3.34,3,35,3.37 to 3.39, 3.46 to 3.48 of text 1)

Module IV (23 hrs)

Expansions of sin nx , cos nx , tannx , $sin^n\theta$, $cos^n\ \theta$, $sin^n\theta cos^n\ \theta$ Circular and hyperbolic functions, inverse circular and hyperbolic function. Separation into real and imaginary parts. Summation of infinite series based on C + iS method. (Geometric, Binomial, Exponential, Logarithmic and Trigonometric series)

(Sections in Chapter 3 sections 27-34, Chapter 4 sections 42-47, Chapter 5 sections 56-78, Chapter 8 sections 103-107 of Text 2)

References

1) Matrices, Schaum's Outline Series, Tata McGraw Hill Publications

2) Differential Equations, by Shepley L Ross, Wiley.

3) Differential Equations, with applications and Historical notes, by G.F. Simmons and S.G.Krantz, Tata McGraw Hill Publications

4) Elements of Partial Differential Equations, by Ian Sneddon, Tata McGraw Hill Publications

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Complementary Course – 4

Course Title	Fourier Series, Laplace Transforms, Fourier Transforms, and Groups.
Course Code	23U4CPMAT04
Semester	4
Credits	4
Contact Hours per week	5
Contact hours per semester	90

Text Books:

1. A text book of Engineering Mathematics, by N.P Bali, Manish Goyal,Lakshmi publications, Eighth edition

2. A First Course in Abstract Algebra, by John B Fraleigh, Seventh edition, Pearson Education.

Course Objectives:

The objectives of the course include

1) introduce the concepts of Fourier Series, Fourier and Laplace Transforms and their applications in the physical world.
2) introduce the concept of groups which is very useful in studying symmetry of molecular structures.

Course Outcomes

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Find the Fourier series expansion of a given periodic function in a specified interval.	PO1/PSO4	AP	F,P	20	0

CO2	Find the Fourier transform of a given function.	PO1/PSO4	U	F,P	18	0
CO3	Find the Laplace transform of a given function.	PO1/PSO4	U	F,P	14	0
CO4	Understand the concepts of groups, cyclic groups, permutation groups	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Module I (23 hrs)

Periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, Change of interval, Half range series

(Sections 10.1 to 10.7 of text 1)

Module II (23 hrs)

Definitions, Properties, Inverse Laplace transforms, Convolution theorem, Application to differential equations.

(Sections 18.1 to 18.12 of text 1)

Module III (22 hrs)

Fourier Integral theorem, Fourier Sine and cosine Integrals, Complex form of Fourier Transforms. Inversion formula

(sections 20.1.to 20.5 of text 1)

Module IV (22 hrs)

Binary systems, Groups, Elementary properties of groups, finite groups, sub groups, cyclic groups, Lagrange's theorem, Permutation groups. (proofs are excluded)

(Chapter 1 to 6 of text 2)

References

1) Advanced Engineering Mathematics by Michael D Greenberg, Pearson Education, 2002

2) Advanced Engineering Mathematics by Erwin Kreyszig, Eighth edition, Wiley, India.

3) Higher Engineering Mathematics, by B.S. Grewal, Khanna Publishers.

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

7. SYLLABUS FOR MATHEMATICS COURSES OF B Sc. COMPUTER APPLICATION

SEMESTER 1

Course Code	23U1CRCMT1
Title of the course	Foundation of Mathematics
Semester in which the course is to be taught	1
No. of credits	3
No. of contact hours per week	4
Total Hours	72

Course Objectives

The objective of the course is

1) to explain the fundamental ideas of sets and functions.

2) to introduce basic logic.

3) to introduce basic Number Theory.

Course Outcomes

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Prove statements about sets and functions	PO1/PSO4	AP	F,P	20	0
CO2	Analyse statements using truth tables	PO1/PSO4	AN	F,P	18	0
CO3	Construct simple proofs	PO1/PSO4	AN	F,P	14	0

CO4	Familiarize mathematical symbols and standard methods of proofs	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Text Books:

1) K.H. Rosen: Discrete Mathematics and its Applications (Sixth edition), Tata McGraw Hill Publishing Company, New Delhi.

2) S. Bernard and J.M Child: Higher Algebra, AITBS Publishers, India,2009

Module I (15 hrs)

Set theory: Sets, set operations, functions, sequences and summations

(Text - 1 Chapter – 2)

Module II (20hrs)

Relations: Relations and their properties, n-ary relations and their applications, representing relations, equivalence relations, partial orderings.

(Text – 1 Chapter 7 excluding Section 7.4)

Module III((20 hrs)

Propositional logic, Propositional equivalences, Predicates and quantifiers nested quantifiers, Rules of inference, Introduction to proofs, Proof methods and strategy.

(Text book 1, Chapter - 1).

Module IV (17 hrs)

Syllabus: Divisibility theory in the integers, the greatest common divisor, the Euclidean algorithm (division algorithm), Primes. The fundamental theorem of arithmetic. The theory of congruence. Basic properties of congruence. Fermat's little theorem Wilson's theorem. Euler's phi-function. Euler's generalization of Fermat's theorem.

(Text – 2, Chapter – 1 and 26)

References:

1, Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi. (Reprint 2009).

2. P.R. Halmos : Naive Set Theory, Springer. .

3. George E. Andrews : Number Theory, HPC.

4. Ian Chiswell & Wifrid Hodges: Mathematical Logic, Oxford university press

5. Graham Everest, Thomas Ward: An Introduction to Number Theory, , Springer

6. Fernando Rodriguez Villegas: Experimental Number Theory, Oxford University Press

7. Richard Johnsonbaugh – Discrete Mathematics (Pearsons)

8. C.Y Hsiung Elementary Theory of Numbers, Allied Publishers

9. Thomas Koshy - Elementary Number Theory with Applications, Academic Press

QUESTION PAPER PATTERN

MODULE	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total number of questions	12	8	4	24
Maximum marks	20	25	30	75

Semester – 2

Course Code	23U2CRCMT2
Title of the course	Calculus
Semester in which the course is to be taught	2
No. of credits	3
No. of contact hours per week	5
Total Hours	90

Course Objectives

The course objective is

1) To explain reduction formulae in calculus

2) To know more about applications of integrals

3) To introduce double integral, triple integrals and its applications

4) To introduce partial differential equations

Course Outcomes

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Find the higher order derivative of the product of two functions.	PO1/PSO4	AP	F,P	20	0
CO2	Expand a function using Taylor's and Maclaurin's series.	PO1/PSO4	AN	F,P	18	0

CO3	Learn about partial derivatives and its applications.	PO1/PSO4	AN	F,P	14	0
CO4	Find the area under a given curve, length of an arc and find the area and volume by applying the techniques of double and triple integrals.	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Text Books :

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.

2. Shanti Narayan and P. K. Mittal– Differential Calculus (S. Chand & Co.) 2008.

Module I(30hrs)

Successive Differentiation, Expansion of functions using Maclaurin's theorem and Taylor's theorem. Concavity and points of inflexion. Curvature and Evolutes. Length of arc as a function derivative of arc, radius of curvature – Cartesian equations. Centre of curvature, Evolutes and Involutes, properties of evolutes. Asymptotes and Envelopes. (Pedal equation and Newtonian Method excluded) (Text 2 Chapter - 5, Chapter – 6, Chapter 13, Chapter – 14, Chapter - 15 section 15.1 to 15.4, Chapter – 18 section 18.1 to 18.8)

Module II (20 hrs)

Partial derivatives, the chain rule. Extreme values and saddle points, Lagrange multipliers, Partial derivatives with constrained variables. (Text 1 Section 14.3, 14.4, 14.7, 14.8, 14.9)

Module III (20 hrs)

Substitution and area between curves, volumes by Slicing and rotation about an axis. Volumes by cylindrical shells, Lengths of Plane Curves, Areas of surfaces of Revolution and the theorems of Pappus. (Text 1 Section 5.6, 6.1, 6.2, 6.3, 6.5)

Module IV (20 hrs)

Double integrals, Areas, Double integrals in polar form, Triple integrals in rectangular coordinates, Triple integrals in cylindrical and spherical coordinates, substitutions in multiple integrals. (Text 1 Section 15.1, 15.2 (area only) 15.3, 15.4, 15.6, 15.7)

References

1. T. M. Apostol – Calculus Volume I & II (Wiley India)

2. Widder – Advanced Calculus ,2nd edition

3. K. C. Maity & R. K. Ghosh – Differential Calculus (New Central Books Agency)

4. K. C. Maity & R. K. Ghosh – Integral Calculus (New Central Books Agency)

5. Shanti Narayan, P.K. Mittal - Integral Calculus – (S. Chand & Co.)

6. Anton: Calculus, Wiley.

Question Paper Pattern

MODULE	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total number of questions	12	8	4	24
Maximum marks	20	25	30	75

Semester 3

Course Code	23U5CRCMT3
Title of the Course	Algebra
Semester	5
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Book:

A First Course in Abstract Algebra (7th Edition), John B Fraleigh .

Course Objectives:

The course objective is to

1) introduce the concept of groups and related concepts including subgroups, cyclic groups, abelian and non-abelian groups, permutation groups, Lagrange's Theorem, Normal subgroups and Factor groups and homomorphisms and simple groups.

2) introduce the concepts of ring, ring with unity, commutative ring, integral domain, division ring, fields, ideals, Factor rings and prime and maximal ideals.

Course Outcomes:

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand concepts of binary operations and groups	PO1/PSO2	U	F	25	0
CO2	Understand the concepts of subgroups, cyclic group	PO1/PSO2	U	F,C	15	0

CO3	Understand Lagrange's theorem and its applications	PO1/PSO2	U	F,C	10	0
CO4	Understand the concepts of homomorphism and factor groups	PO1/PSO2	U	F,P	10	0
CO5	Compute factor groups	PO1/PSO2	AP	P,C	10	0
CO6	Understand the concepts of Rings, Fields, Integral Domains ,ideals	PO1/PSO2	U	C	20	0
	Total Number of Hours				90	0

Bridge Course

Basic Logic (Negation, Converse, Counterpositive of Statements, Methods of Proof) , Sets and relations, Functions, Types of Functions.

Module I (25 hrs)

Binary Operations, Isomorphic Binary Structures, Groups, subgroups and Cyclic Groups.

(Sections 2-6 of the text)

Module II (25 hrs)

Groups of Permutations, Orbits, Cycles, and the Alternating Groups, Cosets and the Theorem of Lagrange, Direct Products

(Sections 8-10 and Section 11.1-11.11 of the Text)

Module III (20 hrs)

Homomorphisms, Factor Groups, Factor Group Computations and Simple Groups.

(Sections 13-15 of the Text)

Module IV (20 hrs)

Rings and Fields, Integral Domains, Fermat's and Euler's Theorems, Homomorphisms and Factor Rings, Prime and Maximal Ideals (Proofs of Theorems 26.3,26.7,26.9 and 26.17 are to be excluded)

(Sections 18-20, 26 and 27.1-27.20).

References

1) Topics in Algebra by I.N. Herstein, Wiley Student Edition.

2) Contemporary Abstract Algebra by Joseph A Gallian, Narosa Publishing House.

3) Algebra by Michael Artin , PHI

4) Abstract Algebra by David S Dummit and Richard M Foote

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total No of Questions	12	8	4	24
Total Marks	20	25	30	75

Semester- 3

Course Code	23U3CRCMT4
Title of the course	Numerical Analysis and Matrices
Semester in which the course is to be taught	3
No. of credits	4
No. of contact hours per week	5
Total Hours	90

Use of Non Programmable Scientific Calculator is Permitted

Text Books :

1. S. S. Sastry - Introductory Methods of Numerical Analysis , PHI Learning

Private Limited Fifth Edition

2. Engineering Mathematics, N P Bali, Manish Goyal

Module I (20 hrs)

Solution of Equations

(A quick review mathematical preliminary, errors, algebraic and transcendental equations) Bisection Method, Method of False Position, Iteration Method, Aitken's Δ process, Newton–Raphson Method, Generalised Newton's Method and Ramanujan's Method

Text 1: Chapter 2 (Sections 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6)

Module II (18 hrs)

Errors in Polynomial Interpolation, Forward Differences, Backward Differences, Central Differences Symbolic Relations, Difference of a Polynomial and Newton's Formulae for Interpolation Text 1: Chapter 3 (Sections 3.1, 3.2, 3.3, 3.5 and 3.6)

Module III (20 Hrs)

Introduction, numerical differentiation and errors in numerical differentiation. Numerical

Integration, Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Boole's and Weddle's Rules.

Text 1: Chapter 6 (Sections 6.1, 6.2: 6.2.1. Sections 6.4: 6.4.1, 6.4.2, 6.4.3 and 6.4.4)

Module IV (25 hrs)

Elementary Transformations, Elementary Matrices, Inverse of Matrix by E-operations (Gauss-Jordan method), Rank of a Matrix, Solution of a System of Linear Equations, If A is a Non-Singular Matrix, then the Matrix Equation AX = B has a Unique Solution, Vectors, Linear dependence and Linear Independence of Vectors, Linear Transformations, Orthogonal Transformation, Complex Matrices, Characteristic Equation, Eigen Vectors, Cayley Hamilton Theorem

(Sections 3.34-3.35 and 3.37-3.48 of Text 1)

References

1.Shanti Narayan - Matrices (S. Chand & Company)

2. Scarborough: Numerical Mathematical Analysis

3. Francis Shield (Schaum's Series): Numerical Analysis

4. Hilderbrand: Introduction to Numerical Analysis

5. Matrices, Schaum's outline series, Tata McGraw Hill Publications.

Question Paper Pattern

MODULE	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	2	1	6
Total number of questions	12	8	4	24
Maximum marks	20	25	30	75

Semester 4

Course Code	23U4CRCMT5
Title of the course	Differential Equations
Semester in which the course is to be taught	4
No. of credits	5
No. of contact hours per week	6
Total Hours	108

Text Books:

1. Shepley L. Ross - Differential Equations, 3rd ed., (Wiley India).

2. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)

Module I (25 hrs)

Ordinary differential equations: Exact differential equations and integrating factors (proof of theorem 2.1 excluded) separable equations and equations reducible to this form, linear equations and Bernoulli equations, special integrating factors and transformations. Orthogonal and oblique trajectories. (Sections 2.1, 2.2, 2.3, 2.4, 3.1 of Text 1)

Module II (30 hrs)

homogeneous linear equation with constant coefficients. The method of undetermined coefficients, Variation of parameters, The Cauchy – Euler equation. (Section 4.1, 4.2, 4.3, 4.4, 4.5 of Text 1)

Module III (33 hrs)

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

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

Module IV (20 hrs)

Surfaces and Curves in three dimensions, solution of equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method (Chapter 1, section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text 2)

References:

1) A.H. Siddiqi & P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)

2) George. F. Simmons – Differential equation with applications and historical notes (Tata Mc Graw Hill)

3) W.E. Boyce & R.C. Diprima - Elementary Differential Equations and boundary value Problems, (Wiley India)

4) S. Balachandra Rao & H. Ranuradha – Differential Equation with Applications and Programs (Universities Press)

5) R. K. Ghosh & K. C. Maity - An Introduction to Differential Equations (New Central Books Agency)

6) B. K. Dutta – Introduction to Partial Differential Equations (New Central Books) .

7) Murrary –.Differential Equations. Macmillian

8) E.A. Coddington - An Introduction to Ordinary Differential Equation, PHI.

9)Sankara Rao - Introduction to Partial Differential Equation,2nd edition, PHI.

10)Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

Question Paper Pattern

MODULE	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total number of questions	12	8	4	24
Maximum marks	20	25	30	75

Semester – 5

Course Code	23U4CRCMT6
Title of the course	Linear Algebra and Graph Theory
Semester	5
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Books :

1 Linear Algebra An Introduction (Second Edition), by Richard Bronson, Gabriel B. Costa - Academic Press 2009, an imprint of Elsevier.

2. A first look at graph theory, by John Clark Derek, Allen Holton Allied Publishers

Course Objectives:

The objectives of the course are to introduce the topics of linear algebra and graph theory to the student.

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand the concepts of vector space, subspace, linear independence, dimension and row space.	PO1/PSO2	U	F	25	0
CO2	Understand the concepts of linear transformation and matrix representation	PO1/PSO2	U	F,C	25	0
CO3	Understand the concepts of different types of graphs.	PO1/PSO2	U	F,C	20	0

CO4	Understand the concept of matching in a graph, the Marriage problem and various assignment problems	PO1/PSO2	U	F,P	20	0
	Total Number of Hours				90	0

Module I (25 hrs)

Vector spaces: Vectors, Subspace, Linear Independence, Basis and Dimension, Row Space of a Matrix.

(Chapter – 2 Sections 2.1, 2.2, 2.3, 2.4, 2.5 of text 1)

Module II (25 hrs)

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

(Chapter –3 Sections 3.1, 3.2, 3.3, 3.4, 3.5 of text 1)

Module III (20 hrs)

An introduction to graph. Definition of a Graph, More definitions, Vertex Degrees, Sub graphs, Paths and cycles, the matrix representation of graphs, Trees. Definitions and Simple properties, Bridges, Spanning trees. Cut vertices and Connectivity.

Text 1: Chapter 1 (Sections 1.1 to 1.7) Text 1: Chapter 2 (Sections 2.1, 2.2,2.3, & 2.6)

Module IV (20 hrs)

Euler's Tours, the Chinese postman problem. Hamiltonian graphs & the travelling salesman problem, Matching and augmenting paths, Hall's Marriage theorem (Statement only), Personnel assignment problem, the optimal assignment problem.

Chapter 3 Sections 3.1 (algorithm deleted), 3.2 (algorithm deleted), 3.3, and 3.4 (algorithm deleted), Chapter 4.1, 4.2, 4.3(Algorithm deleted) ,4.4(Algorithm deleted).

References

1)Linear Algebra Done Right, Sheldon Axler, Springer, 2015.

2) Linear Algebra, A Geometric Approach by S Kumaresan, PHI Learning Pvt.Ltd,

3) Linear Algebra, David C Lay, Pearson Education.

4) Introduction to Graph Theory by Douglas B West, Pearson Education.

5) A Text Book of Graph Theory by R. Balakrishnan and K. Ranganathan, Springer,2013.

6) Graph Theory by Frank Harary

Question Paper Pattern

Module	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	2	1	6
Total No of Questions	12	8	4	24
Maximum Marks	20	25	30	75

Semester -6

Course Code	23U5CRCMT7
Title of the course	Mathematical Analysis
Semester in which the course is to be taught	5
No. of credits	4
No. of contact hours per week	5
Total Hours	90

Course objectives

1)To study elementary properties of real numbers.

2)To introduce sequences and series and their properties .

3)To introduce the limit of a function.

Course outcomes

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Understand the order and completeness property of R	PO1/PSO2	U	F	30	0
CO2	Understand theorems on limits	PO1/PSO2	A	F,C	30	0
CO3	Understand series and test their convergence	PO1/PSO2	AP	F,C	24	0
CO4	study limit theorems	PO1/PSO2	U	F,P	24	0
	Total Number of Hours				108	0

Text Books :

1. S.C.Malik, Savitha Arora _ Mathematical analysis. RevisedSecond edition.

2. J.W. Brown and Ruel.V.Churchill _ Complex variables and applications, 8th edition. Mc.Graw Hill.

Module I (15 hrs)

Intervals. Bounded and unbounded sets, supremum, infimum. Order completeness in R. Archimedian property of real numbers. Dedekinds form of completeness property. (Sections 2.6, 3, 4.1 ,4.2, 4.3, 4.4 of text 1)

Module II (25 hrs)

Neighbourhood of a point. Interior point of a set. Open set. Limit point of a set. Bolzano Weierstrass theorem for sets. Closed sets, closure of a set. Dense sets. Countable and uncountable sets. (Sections: 1.1,1.2,1.3,2,2.1,2.2,3.1,3.2,3.3,3.4,3.5,4 of chapter 2 of text 1)

Module III (30 hrs)

Real sequences. The range, bounds of a sequence. Convergence of sequences. Some theorems, limit points of a sequence. Bolzano Weierstrass theorem for sequences. Limit interior and superior. Convergent sequences. Cauchy's general principle of convergence. Cauchy's sequences. Statements of theorem without proof in algebra of sequences. Some important theorems and examples related to them. Monotonic sequences, sub sequences. (Sections: 1.1,to 1.5, 2.to2,3. 4 to5 ,6 ,6.1 ,7,8 9, 9.1 of chapter 3 of text 1)

Module IV (20 hrs)

Limits, Continuity and Differentiability: Limits, Left hand limit and right hand limit, theorems on limits, limit of a function, limit of a function (sequential approach), Cauchy's criterion for finite limits, Continuous functions, theorems on continuity, continuous functions on a finite closed interval, uniform continuity, derivability at a point, increasing and decreasing functions, Darboux's theorem, Intermediate value theorem for derivatives**.**

Text 1 Chapter 5: Sections 1 ,1.1 ,1.2 ,1.3, 2.1, 2.2, 2.3,2.4, 3, 4, 4.1.

Chapter 6. Sections, 1, 2, 3, 3.1, 4

References

1) Robert G Bartle and Donald R Sherbert, Introduction to Real analysis, 3rd edition.
2) Richard R Goldberg, methods of analysis, 3rd edition, oxford and IBM publishing co. 1964.
3) Shanti Narayan, A course of Mathematical analysis S Chand and co ltd,2004.
4) Elias Zako, Mathematical analysis vol. 1, overseas press, New Delhi ,2006.
5) J M Howie, Real analysis, Springer, 2007
6) K A Ross, Elementary Real analysis, Springer, Indian reprint

Question Paper Pattern

Module	Part A (2 marks)	Part B (5 marks)	Part C (10 marks)	Total
I	4	2	1	7
II	4	2	1	7
III	3	3	1	7
IV	1	1	1	3
Total number of questions	12	8	4	24
Maximum marks	20	25	30	75

8. SYLLABUS FOR MATHEMATICS COURSES OF BCA PROGRAMME

Semester- 1

Course Code	23U1CPCMT1
Title of the course	Foundation of Mathematics
Semester in which the course is to be taught	1
No. of credits	3
No. of contact hours per week	4
Total Hours	72

Course Objectives

The objective of the course

1) to explain the fundamental ideas of sets and functions;

2) to introduce basic logic;

3) to introduce basic Number Theory

Course Outcomes

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Prove statements about sets and functions	PO1/PSO4	AP	F,P	20	0

CO2	Analyse statements using truth tables	PO1/PSO4	AN	F,P	18	0
CO3	Construct simple proofs	PO1/PSO4	AN	F,P	14	0
CO4	Familiarize mathematical symbols and standard methods of proofs	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Text Books:

1. K.H. Rosen: Discrete Mathematics and its Applications (Sixth edition), Tata McGraw Hill Publishing Company, New Delhi.

2. S. Bernard and J.M Child: Higher Algebra, AITBS Publishers, India,2009

Module I (15 hrs)

Set theory: Sets, set operations, functions, sequences and summations

(Text - 1 Chapter – 2)

Module II (20hrs)

Relations: Relations and their properties, n-ary relations and their applications, representing relations, equivalence relations, partial orderings.

(Text – 1 Chapter 7 excluding Section 7.4)

Module III (20 hrs)

Propositional logic, Propositional equivalences, Predicates and quantifiers nested quantifiers, Rules of inference, Introduction to proofs, Proof methods and strategy.

(Text book 1, Chapter – 1).

Module IV (17 hrs)

Syllabus: Divisibility theory in the integers, the greatest common divisor, the Euclidean algorithm (division algorithm), Primes. The fundamental theorem of arithmetic. The theory of congruence. Basic properties of congruence. Fermat's little theorem Wilson's theorem. Euler's phi-function. Euler's generalization of Fermat's theorem.

(Text – 2, Chapter – 1 and 26)

References

1, Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi. (Reprint 2009).

2. P.R. Halmos : Naive Set Theory, Springer. .

3. George E. Andrews : Number Theory, HPC.

4. Ian Chiswell & Wifrid Hodges: Mathematical Logic, Oxford university press

5. Graham Everest, Thomas Ward: An Introduction to Number Theory, , Springer

6. Fernando Rodriguez Villegas: Experimental Number Theory, Oxford University Press

7. Richard Johnsonbaugh – Discrete Mathematics (Pearsons)

8. C.Y Hsiung Elementary Theory of Numbers, Allied Publishers

9. Thomas Koshy - Elementary Number Theory with Applications, Academic Press

Question Paper Pattern

MODULE	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total questions	12	8	4	24
Maximum marks	20	25	30	75

Semester -2

Course Code	23U1CPCMT2
Title of the course	Discrete Mathematics
Semester in which the course is to be taught	2
No. of credits	3
No. of contact hours per week	4
Total Hours	72

Course Objectives

The objective of the course is

1)to explain the fundamental ideas of complex numbers;

2) to introduce basic Number Theory;

3) to introduce basic logic

4) to introduce graph theory concepts

Course Outcomes

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Solve algebraic operations using complex numbers	PO1/PSO4	AP	F,P	20	0
CO2	solve number theory problems	PO1/PSO4	AN	F,P	18	0
CO3	analyse propositions	PO1/PSO4	AN	F,P	14	0
CO4	use algorithms to solve problems in daily life	PO1/PSO4	U	F,C	20	0
	Total Number of Hours				72	0

Text Books

1.Engineering Mathematics, N.P. Bali, Manish Goyal

2. Petergray – Logic, Algebra and databases (chapter 3), Affiliated East West press pvt Ltd.

3.Robert J McEliece, Robert B Ash and Carol Ash – Introduction to discrete mathematics (chapter 1,2 and 4), McGraw Hill.

Module I (17 hrs)

Complex Numbers, Conjugate complex numbers, Geometrical representation of complex numbers, Properties of complex numbers, Standard form of a complex number, De Morgan's theorem, Roots of a complex number (Sections 1.3-1.7, 1.9,1.10)

Module II (15 hrs)

The theory counting. The multiplication rule, ordered sample and permutations, unordered samples without repetition, permutations involving indistinguishable objects, multinomial co-efficient, unordered samples with repetition, permutation involving indistinguishable objects.

Module III(15 hrs)

Proposition, compound proposition, truth table for basic operators, connectives, theorems from Boolean algebra, De-Morgan's law, normal forms, rules of inference, chain rule and modusponens, chains of inference, tautology, proof by adopting a premise. Reductio- ad-absurdum, proof by resolution.

Module IV (25 hrs)

Leonhard Euler and the seven bridges of Konigsberg, trees and spanning trees, minimal spanning trees, binary trees and tree searching. Planar graphs and Euler's theorem, the shortest path problem, Dijkstras Algorithm, two "all-pairs" Algorithm, Floyd's Algorithm and Marshal's Algorithm.

References:

1.James Ward Brown, Ruel V. Churchill: Complex Variables and Applications (8^{th} edition), McGraw Hill International Edition.

2.S. Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi.

3. R.G..Stoll- Set Theory and Logic

4. P.R. Halmos -Naive Set Theory, Springer

5. John Clark & Derek Allen Holton- A first book at graph theory (Allied Publishers)

5. Douglas B west – Introduction to Graph Theory, Pearson Education

Question Paper Pattern

MODULE	Part A (2 Marks)	Part B (5 Marks)	Part C (10 Marks)	Total
1	3	2	1	6
2	3	2	1	6
3	3	2	1	6
4	3	2	1	6
Total number of questions	12	8	4	24
Maximum marks	20	25	30	75

9. **SAMPLE QUESTION PAPER**

Reg No. …….
Name……. QP code

BSc End Semester Examination

Semester -2: MATHEMATICS (CORE COURSE FOR MATHEMATICS)

COURSE: 23U2CRMAT02- Advanced Calculus and Trigonometry

Time: Three hours **Max Marks: 75**

Part-A

Each question carries 2 marks. Maximum mark from this section is 20

1) Find the third derivative of xe^x.
2) If $= ax^3 + b$, prove that $x^2y'' = 2y$.
3) Sketch the graph of r = 2.
4) Sketch the graph of $\theta = \frac{\pi}{4}$
5) Find the total arclength of the cardioid $r = 1 + cos\theta$
6) Find the slope of the tangent line to the curve $r = sin3\theta$, $\theta = \frac{\pi}{4}$
7) Evaluate $\int_0^2 \int_0^3 (x + 3)dxdy$
8) Use double integral to find the area of the circle $x^2 + y^2 = 1$.
9) Describe triple integral in cylindrical coordinates.
10) Separate into real and imaginary parts tan(a+ib).
11) Separate into real and imaginary parts cosh(a+ib).
12) Describe triple integral in spherical coordinates.

Part- B

Each question carries 5 marks. Maximum mark from this section is 25

13) Find the nth derivative of $\frac{x^2}{(x-2)(x-1)^2}$
14) Find the asymptotes of $x^3 + y^3 = 3axy$.
15) Sketch the graph of $r = a(1 - cos\theta), \theta > 0$.

16) Find the entire area within the rose curve $r = cos2\theta$

17) Find the volume of the region bounded by the coordinate planes and the tetrahedron $2x + 3y + 4z = 12.$

18) Find the surface area of the portion of the surface $z = \sqrt{4 - x^2}$ that lies above the rectangle R in the xy plane whose coordinates satisfy $0 \leq x \leq 1, 0 \leq y \leq 4.$

19) Prove that $sinh^{-1}(x) = \log(x + \sqrt{x^2 + 1})$.

20) Resolve into factors $x^n - 1.$

Part- C

(Each question carries 10 marks. Maximum mark from this section is 30)

21) Sum the series $sin \propto + \frac{1}{2} sin2 \propto + \frac{1}{2^2} sin3 \propto + \cdots$

22) Use spherical coordinates to find the volume of the solid G bounded by the sphere $x^2 + y^2 + z^2 = 16$ and below by the cone $z = \sqrt{x^2 + y^2}$.

23) State and prove Leibnitz theorem

24) A) Find the iterated integral using polar coordinates

$$\int_0^1 \int_0^{\sqrt{1-x^2}} x^2 + y^2 \, dydx$$

B) Use spherical coordinates to find the volume of the hemisphere $\rho = 3$.