SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA – 682013

Affiliated to Mahatma Gandhi University, Kottayam.

CURRICULUM AND SYLLABI

CHOICE BASED CREDIT SEMESTER SYSTEM (CBCSS - UG)

UNDERGRADUATE PROGRAMME

IN

MATHEMATICS

(Effective from 2019 admission onwards)

BOARD OF STUDIES IN MATHEMATICS

Sacred Heart College (Autonomous), Thevara, Kochi – 13

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Undergraduate Programme Outcomes (Pos)

PO1 : Critical Thinking & Deep Domain Knowledge

PO2 : Effective Communication

PO3 : Contribute to Nation Building

PO4 : Care for the Environment

PO5 : Ethical Values

PO6 : Global Perspective

Programme Specific Outcomes (PSOs)

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

REGULATIONS FOR CHOICE BASED CREDIT AND SEMESTER SYSTEM (CBCSS) UNDER GRADUATE PROGRAMME IN MATHEMATICS

(EFFECTIVE FROM 2019 ADMISSION ONWARDS)

Preamble

Sacred Heart College, Thevara became an autonomous college under Mahatma University Kottayam in 2014. The college revised the choice based credit and semester system (CBCSS) for under graduate programmes from 2015-16 academic year and credit and semester system (CSS) for postgraduate programmes from 2016-17 academic year onwards. Since the world is undergoing technological revolutions that is fundamentally changing the way we live, work and relate to one another, it becomes necessary to update the curriculum and syllabi of various programmes. Keeping this in mind, the Academic Council which met on 21-07-2018, revised the CBCSS regulations for under graduate programmes which shall be effective from 2019 admission onwards.

1.Title

These regulations shall be called **"SACRED HEART COLLEGE THEVARA REGULATIONS FOR CREDIT AND SEMESTER SYSTEM 2019"**

2.1 Scope

Mathematics is as old as civilisation itself and is one of the most useful and fascinating branches of human knowledge . It encompasses many topics of study and as such it is difficult to define the term ʻmathematicsʼ which comes from the Greek word with meaning ʻinclined to learnʼ .It may, however, be broadly defined as the scientific study of quantities, including their relationships, operations and measurements expressed by numbers and symbols. In simple words, mathematics deals with the study of numbers and their different calculations . The most important skills in mathematics are careful analysis and reasoning, and thus logic is the floor on which the structure of mathematics is built .The B.Sc.Mathematics programme provides in depth knowledge in geometry, trigonometry, calculus, algebra, number theory, analysis, matrix theory, metric spaces, graph theory etc. In this programme we shall also study the application oriented topics like operations research, game theory, Fourier series , Laplace transforms, differential equations, numerical methods etc. These topics are applied commonly in the disciplines economics , physics etc.

2.2 Programme Objectives:

- Giving the students a sufficient knowledge of fundamental principles methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modelling, solving and interpreting .
- Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science .
- Enhancing the students overall development and equipping them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment .
- A student should get adequate exposure to global and local concerns that explore the many aspects of mathematical sciences .

2.3 Student Attributes

- Critical thinking, problem solving and research aptitude.
- Deep domain knowledge.
- Leadership qualities.
- Teamwork and communication skills.
- Self awareness and emotional intelligence.
- Awareness of mathematical concepts for further study in various fields of science.
- Awareness of the applications of mathematics in day to day life.
- Mathematical modelling expertise.
- Knowledge of fundamental principles of mathematics and their applications in modelling, problem solving and interpretation.

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.

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.

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

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

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

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

v. The U.G. programmes shall include (a) Common courses I & II, (b) Core courses, (c) Complementary Courses, (d) Open Course (e) Additional core course. (f) Study tour (g) Internship for selected programmes.

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

vii. **'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.

viii. '**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 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)

ix. '**Programme Credit'** means the total credits of the UG Programmes.

x. **'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.

xi. '**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.

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

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

xiv. '**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.

xv. '**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.

xvi. '**Evaluation'** means every course shall be evaluated by 25% internal assessment and 75% external assessment.

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

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

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

xx. '**Parent Department'** means the Department which offers a particular Under Graduate programme.

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

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

xxiii. '**College Coordinator** means a teacher from the college nominated by the College Council to look into the matters relating to CBCSS-UG System

xxiv. **'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.

xxv. 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.

xxvi. **'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.

xxvii. '**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.

xxviii. **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.

xxix. '**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.

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 he/she 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 a distraction to the class as such; though attendance **may not be given**. Late arrival beyond 5 minutes is treated as **abscence**; 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. The student is supposed to report in prescribed format on the very next day of the absence; however, up to a week's time is permitted. Afterwards, the leave applications **will not be** considered. 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.

vi. **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.

vii. **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.

viii. **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 and that of PG programmes only one opportunity.

ix. **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 council, 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.

x. **UNAUTHORIZED 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.

5. 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.

6. PROMOTION: A student who registers for the end semester examination shall be promoted to the next semester.

7. UNDER GRADUATE PROGRAMME STRUCTURE

MODEL - 1.

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%

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 consisting 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.

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. 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 for theory courses shall be for a maximum of **60** marks and internal evaluation for **20** marks. The practicals are conducted on an annual basis with an internal component of **10** marks and **30** marks for the external practical examination.Both internal and external evaluation shall be carried out in the mark system and the marks are to be rounded to the nearest integer.

a. 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.

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**

Attendance Evaluation for the course without practical

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

iv. **Class Tests**

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

b. 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 centralized valuation.

c. MARKS DISTRIBUTION FOR INTERNAL AND EXTERNAL EVALUATION

For all courses without practical, the following are the distribution of marks for internal and external

(a) Maximum marks for internal evaluation **25**

(b) Maximum marks for external evaluation **75**

The following components of the internal assessment are mandatory

Components of internal assessment	Marks
Attendance	**5**
Assignment	**5**
Seminar / Viva	**5**
Two test papers	**10**
Total	**25**

***For the common course English in the first semester , internal oral examination shall be conducted instead of test paper .**

Project Evaluation (Maximum marks 100) :

Components of Project evaluation	**Marks**
Dissertation	**50**
Internal	**25**
Presentation	**25**
Total	**100**

CIA FOR THE COMPLEMENTARY PROGRAMME , PHYSICS

Components of the theory - internal assessment for complementary Physics courses

Components of Theory – Internal Valuation	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 the Practical- internal assessment for complementary Physics courses

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

10. COMPUTATION OF 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
95 and above	O Outstanding	10
85 to below 95	A+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B+ Good	7
55 to below 65	B Above Average	6
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	***O Outstanding***
Equal to 8.5 and below 9.5	***A+ Excellent***
Equal to 7.5 and below 8.5	***A Very Good***
Equal to 6.5 and below 7.5	***B+ Good***
Equal to 5.5 and below 6.5	***B Above Average***
Equal to 4.5 and below 5.5	***C Average***
Equal to 3.5 and below 4.5	***D Pass***
Below 3.5	***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 **UG** programme. 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 will 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 = C x G, where **C** = Credit of the course; **G** = Grade point of the course

10 .1 COMPUTATION OF SGPA

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

For the **i** thsemester **SGPA ,** denoted by $\mathbf{S}_i$,is calculated using thefollowing formula .

$$\mathbf{SGPA\ (S_i) = \sum [\ C_j \times G_j\ ] / \sum C_j}$$

where $\mathbf{C_j}$ is the credit of the $\mathbf{j^{th}}$ course in the $\mathbf{i^{th}}$ semester and $\mathbf{G_j}$ is the grade point of the $\mathbf{j^{th}}$ course in the $\mathbf{i^{th}}$semester

10.2 COMPUTATION OF CGPA

CGPA is calculated using the following formula.

$$\mathbf{CGPA = \sum [\ C_i \times S_i\ ] / \sum C_i},$$

where $\mathbf{S_i}$ is the **SGPA** of the $\mathbf{i^{th}}$semester and $\mathbf{C_i}$ is the total of the credits of all the courses in the $\mathbf{i^{th}}$ semester .

10 .3 ILLUSTRATION OF THE COMPUTATIONOF *SGPA* AND *CGPA*

(a) *Computation of SGPA for semester - 1*

Name of the course	Credit C_J	Grade	Grade point G_j	$C_j \times G_j$
English - 1	4	B	6	24
English common -1	3	B	6	18
Second language -1	4	C	5	20
Core course -1	3	A	8	24
Complementary physics -1	2	A^+	9	18
Complementary statistics -1	3	O	10	30
Total	19			134

Therefore , $S_1 =$ 134/19 = 7.05

(b) ***Computation of CGPA for Bsc. MATHEMATICS programme***

Semester	Total credit C_i	SGPA S_i	$C_i \times S_i$
Semester -1	19	7.05	133.95
Semester -2	21	7.24	152.04
Semester -3	19	7.84	148.96
Semester - 4	21	7.95	166.95
Semester - 5	20	8.75	175
Semester -6	20	9.20	184
Total	120		960.90

Hence , **CGPA** for the programme = **960.90 /120 = 8.0**

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 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.**

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.

12. Supplementary Examinations

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

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.

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.

14. **Certificates**

1. Diploma and 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.

15. Award of Degree

The successful completion of all the courses with ‘D’ grade (40%) shall be the minimum

requirement for the award of the degree.

16. 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.

17. 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.

18 . DETAILED DISTRIBUTION OF COURSES

CBCSS : **B.Sc. MATHEMATICS PROGRAMME (THEORY PAPERS)**

Semester	Name of the course	Contact hours per week	Number of Credits	Maximum marks for internal evaluation	Maximum marks for external evaluation
1	English Common 1	5	4	25	75

1	English Common 2	4	3	25	75
1	Additional language- 1	4	4	25	75
1	Core course -1	4	3	25	75
1	Physics(Complementary course) -1	4	2	20	60
1	Statistics(Complementary course) -1	4	3	25	75
2	English Common 3	5	4	25	75
2	English Common 4	4	3	25	75
2	Additional Language -2	4	4	25	75
2	Core course- 2	4	3	25	75
2	Physics(Complementary course) -2	4	4 (Theory-2 Practical-2)	20	60
2	Statistics(	4	3	25	75

	Complementary course) - 2				
3	English - 5	5	4	25	75
3	Additional language -3	5	4	25	75
3	Core course- 3	5	4	25	75
3	Physics(Complementary course) -3	5	3	20	60
3	Statistics(Complementary course) -3	5	4	25	75
4	English - 6	5	4	25	75
4	Additional language - 4	5	4	25	75
4	Core course - 4	5	4	25	75
4	Physics(Complementary course)-4	5	5 (Theory-3 Practical-2)	20	60
4	Statistics(Complementary course) -4	5	4	25	75

5	Core course -5	6	4	25	75
5	Core course - 6	6	5	25	75
5	Core course - 7	5	4	25	75
5	Core course -8	4	4	25	75
5	Open course	4	3	25	75
6	Core course - 9	5	4	25	75
6	Core course -10	5	4	25	75
6	Core course - 11	5	4	25	75
6	Core course -12	5	4	25	75
6	Core course - 13	4	3	25	75
6	Project	1	1	25	75
Total		150	120		

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

19. 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 to be answered	10	5	3
Total number of questions	12	8	4
Marks per question	2	5	10

TOTAL EXTERNAL MARKS : 75

TOTAL INTERNAL MARKS : 25

Mathematics Core Courses

Semester	Course code	Name of the course	Number of contact hours per week	Total number of hours in the semester	Total credits	End semester external exam duration	Max. marks for internal evaluation	Max.marks for external evaluation
1	19U1CRMAT01	Calculus	4	72	3	3 Hrs	25	75
2	19U2CRMAT02	Advanced Calculus and Trigonometry	4	72	3	3 Hrs	25	75
3	19U3CRMAT03	Vector Calculus, Theory of Equations and Matrices	5	90	4	3 Hrs	25	75
4	19U4CRMAT04	Analytic Geometry, Numerical Methods and Number Theory	5	90	4	3 Hrs	25	75
5	19U5CRMAT05	Real Analysis - 1	6	108	4	3 Hrs	25	75
5	19U5CRMAT06	Differential Equations	6	108	5	3 Hrs	25	75
5	19U5CRMAT07	Algebra	5	90	4	3 Hrs	25	75

5	19U5CRMAT08	Human Rights and Mathematics for Environmental Studies	4	72	4	3 Hrs	25	75
6	19U6CRMAT09	Real Analysis - 2	5	90	4	3 Hrs	25	75
6	19U6CRMAT10	Complex Analysis	5	90	4	3 Hrs	25	75
6	19U6CRMAT11	Linear Algebra and Graph Theory	5	90	4	3 Hrs	25	75
6	19U6CRMAT12	Fourier Series , Laplace Transforms and Metric Spaces	5	90	4	3 Hrs	25	75
6	19U6CRMAT13	Operations Research	4	72	3	3 Hrs	25	75
6	19UCRMAT14	Basic Python Programming and Typesetting in LaTeX	4	72	3	3 Hrs	25	75
6	19UCRMAT15	Numerical Analysis	4	72	3	3 Hrs	25	75

6	19U6PJMAT1	Project	1	18	1	NIL	25	75

Mathematics Open Course (Offered for students of other departments)

5	19U5OCMAT1	Applicable Mathematics	4	72	3	3 Hrs	25	75

Mathematics Complementary Courses

Semester	Course code	Name of the course	Number of contact hours per week	Total number of contact hours in the semester	Total credits	End semester examination duration	Maximum marks for internal evaluation	Maximum marks for external evaluation
1	19U1CPMAT01	Calculus- 1	4	72	3	3 Hrs	25	75
2	19U2CPMAT02	Calculus – 2 and Numerical Analysis	4	72	3	3 Hrs	25	75
3	19U3CPMAT03	Differential Equations , Matrices and Trigonometry	5	90	4	3 Hrs	25	75
		Fourier Series ,						

4	19U4CPMAT04	Laplace Transforms , Fourier Transforms, and Groups	5	90	4	3 Hrs	25	75

Total Credits for Core Courses	51
Total Credits for Open Courses	03
Total credits for Complementary Courses	28
Total Credits for English and Second Language	38
Total	120

SYLLABUS OF

CORE COURSES OF B.Sc MATHEMATICS PROGRAMME

Core Course-1

Course Title	Calculus
Course Code	19U1CRMAT01
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 familiarise the students with the various applications of derivatives and definite integrals. The course introduces Rolle's Theorem, Lagranges Mean Value Theorem and their applications. L'Hopital's rule for computing limits of indeterminate forms and hyperbolic functions and their derivatives are also introduced. Functions of more than one variable and consequently partial derivatives are also discussed.

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'Hopitals 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

Analysis of Functions; Increase, Decrease and Concavity, Relative Extrema, Graphing Polynomials,Absolute Maxima and Minima, Applied Maximum and Minimum Problems

(Sections 3.1-3.5 of the text) **(18 Hrs)**

Module II

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

(Sections 3.8 and 6.5 and 6.8 of the text)

(18 Hrs)

Module III

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)

(18 hrs)

Module IV

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)

(18 hrs)

References

1) Thomas Calculus by Maurice Weir, Joel Hass, Frank R Giordano.(11th 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	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
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course 2

Course Title	Advanced Calculus and Trigonometry
Course Code	19U2CRMAT02
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. (10th 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 familiarise the students with the concept of higher order derivatives and their applications. Parametric Equations of curves and their applications are introduced to the student. The course also introduces multiple integrals and their application to area and volume problems.The final module deals with trigonometry.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Compute higher order derivative by applying Leibnitz threorem	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 area and volume problems 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 fuctions, 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), Sin hx, Cos hx, $\tan^{-1}(x)$, $\sin^{-1}(x)$, curvature, evolute, involute, asymptotes and envelopes.

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 imaginaryparts, Factorization of x^n+1, x^n-1,

$x^{2n}-2x^n a^n \cos(n\theta)+a^{2n}$.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.(11th 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
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course -3

Course Title	Vector Calculus, Theory of Equations and Matrices
Course Code	19U3CRMAT03
Semester	3
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

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 upto 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.

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		AP	P	22	0

	of matrices using Cayley Hamilton theorem	PO1/PSO2				
	Total Number of Hours				90	0

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

Module 1 **(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 ∇ .

(Sections 8.10-8.20 of Text 1)

Module 2 **(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 3 **(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 4 **(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.(11^{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
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course 4

Course Title	Analytic Geometry, Numerical Methods and Number Theory
Course Code	19U4CRMAT04
Semester	4
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Course Objectives:

The objectives of the course include teaching the students about conic sections, numerical methods of solving polynomial equations and basic number theory.

CO	**CO Statement**	**PO/ PSO**	**CL**	**KC**	**Class Hrs**	**Lab Hrs**
CO1	Remember the standard equations of parabola, hyperbola, and ellipse	PO1/PSO2	R	F	5	0
CO2	Understand the parametric forms of parabola, hyperbola, and ellipse	PO1/PSO2	U	F,C	8	0
CO3	Classify the second order curves based on their equations	PO1/PSO2	U	F,C	7	0
CO4	Find the equations of line segments and loci related to conic sections	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) Analytic Geometry of Two And Three Dimensions And Vector Analysis. R.M.Khan, New Central Book Agency Pvt. Ltd., London.

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

Education(India) Private Ltd.

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

Module 1 **(20 hrs)**

Parabola, Ellipse, Hyperbola, Second degree homogeneous equation, General equation of second degree, Canonical Form, Reduction to Canonical Form, Rank and classification of second order curves,

(Chapter 1 (Sections 1.50-1.70), Chapter 3 (Section 3.10), Chapter 4 (Section 4.10-4.20),

Module 2 **(25 hrs)**

Equation of tangents, to find equation of the normal, pair of tangents; director circle, chord of contact, pole and polar.Asymptotes, Equation of a hyperbola, Polar coordinates, polar equation of a straight line, polar equation of a circles, polar equation of conic with focus as the pole,

(Chapter 5 (Section 5.10-5.50), Chapter 7 (Section 7.10), Chapter 9 (Sections 9.10-9.40).

Module 3

Numerical methods **(25 hours)**

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

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

Module 4 **(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) Manicavachagom Pillay, Natarajan : Analytic Geometry (Part 1 Two dimensions)

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 1	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
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course -5

Course Title	Real Analysis - I
Course Code	19U5CRMAT05
Semester	5
Credits	4
Contact Hours per week	6
Contact hours per semester.	108

Text Book :

Mathematical Analysis, 4thedition, S.C.Malik Savita Arora, New Age International Publishers, 2015.

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.

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Find the limit points, interior points and closure of a set	PO1/PSO2	U	F	28	0
CO2	Verify the convergence of sequences and series	PO1/PSO2	A	F,C	70	0
CO3	Determine the limits of functions	PO1/PSO2	AP	F,C	5	0
CO4	Understand theorems on limits		U	F,P	5	0

		PO1/PSO2				
	Total Number of Hours				108	0

Module -1 **(28 Hrs)**

Real Numbers

Intervals, bounded and unbounded sets, supremum and infimum of sets, completeness in the set of real numbers, Archimedean property, Dedekind' s form of completeness, absolute value of real numbers, neighbourhood of a point, interior point of a set, limit point of a set, Bolzano – Weierstrass theorem, closed set, closure of a set, dense set, countable and uncountable sets.

Chapter 1:Sections, 2.6, 3,4 ,4.1, 4.2, 4.3 ,5 Chapter 2 .Sections 1.1 ,1.2 ,2 , 2.1,3 3.1 3.2 ,3.3 ,3.4, 3.5 , 4

Module - 2 **(30 Hrs)**

Real Sequences

Sequences, Bounded sequences, convergent sequences, limit point of a sequence, Bolzano - Weierstrass theorem, upper and lower limits of a sequence, limit superior and limit inferior of a sequence, properties (no proof), more properties of convergent sequences, non-convergent sequences, Cauchy's general principle of convergence, Cauchy sequence, Algebra of sequences, some important theorems, Sandwich theorem, Cauchy's first theorem on limits, Cesaro's theorem, Cauchy's second theorem on limits, monotonic sequences, subsequences, nested intervals, Cantor's intersection theorem.

Chapter3 :Sections 1 ,1.1 ,1.2 ,1.3 ,1.4 ,2 ,2.1 ,2.2 ,2.3 ,3 ,4 ,4.1 ,4.2 ,5, 6,6.1,7 ,8 ,9 ,9.1.

Module -3 **(40 Hrs)**

Infinite Series

Introduction of an Infinite series, A necessary condition for convergence of an infinite series, Cauchy's general principle of convergence for an infinite series, series of positive terms, Geometric series, comparison series, comparison tests for series of positive terms, Cauchys root test, D 'Alemberts ratio test, Raabes test, Logarithmic test, Integral test, Cauchys integral test, Gauss's test, Series of positive and negative terms, Alternating series, Leibnitz test, Absolute convergence and related results .

Chapter 4 :Sections , 1 ,1.2 ,1.3 ,1.4 ,2 ,2.1 ,2.2 ,2.3 ,3,3.1,3.2,3.3,4,5,6,7,8,8.1,9,10 ,10.1 ,10.2 .

Module -4 **(10 Hrs.)**

Limits: 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 .

Chapter 5: Sections 1 ,1.1 ,1.2 ,1.3 .

References

1 Robert .G. Bartle and Donald R Sherbert, Introduction to Real analysis, 3rd edn.

2 Richard.R. Goldberg, Methods of Real Analysis, 3rd Edition , Oxford and IBM publishing co. 1964.

3 Shanti Narayan, A course of Mathematical Analysis S chand and Co ltd,2004.

4 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 1	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	2	8
IV	1	1	0	2
Total No of Questions	12	8	4	24
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course - 6

Course Title	Differential Equations
Course Code	19U5CRMAT06
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 equip the student with the methods of solution of differential equations, both ordinary and partial.

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		U	F,P	18	0

	solving the same	PO1/PSO2				
	Total Number of Hours				108	0

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.)**

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.)**

Partial Differential equations

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
No of Questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course - 7

Course Title	Algebra
Course Code	19U5CRMAT07
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 aims at introducing to the student 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. The concepts of ring, ring with unity, commutative ring, integral domain, division ring and field are also introduced.Ideals, Factor rings and prime and maximal ideals are also discussed.

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		U	F,P	10	0

	groups	PO1/PSO2				
CO5	Compute factor groups	PO1/PSO2	AP	P,C	10	0
CO6	Understand the concepts of Rings, Fields, Integral Domains	PO1/PSO2	U	C	10	0
CO7	Understand the concepts of prime and maximal Ideals	PO1/PSO2	U	C	10	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 1 **(25 hrs)**

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

(Sections 2-6 of the text)

Module 2 **(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 3 **(20 hrs)**

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

(Sections 13-15 of the Text)

Module 4 **(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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course - 8

Course Title	Human Rights and Mathematics for Environmental Studies
Course Code	19U5CRMAT08
Semester	5
Credits	4
Contact Hours per week	4
Contact hours per semester.	72

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)

Module I

Unit 1 :Multidisciplinary nature of environmental studies (2 hrs)

Definition, scope and importance

Need for public awareness.

Unit 2 : Natural Resources : **(10 hrs)**

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.

Unit 3: Ecosystems **(6 hrs)**

• Concept of an ecosystem

• Structure and function of an ecosystem

• Producers, consumers and decomposers

• Energy flow in the ecosystem

• Ecological succesion

• Food chains, food webs and ecological pyramids

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

Forest ecosystem

Module II

Unit1:**Biodiversity and its conservation** **(8 hrs)**

- Introduction
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- India as a mega-diversity nation
- Hot-sports of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts

- Endangered and endemic species of India

Unit 2 Environmental Pollution (8hrs)

Definition

Causes, effects and control measures of: -

a.Air pollution

b.Water pollution

c.Soil pollution

d.Marine pollution

e.Noise pollution

f.Thermal pollution

g.Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and

industrial wastes.

- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides.

(8hrs)

Unit 3: Social Issues and the environment (10 hrs)

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people: its problems and concerns, Case studies
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and

holocaust, Case studies

- Consumerism and waste products

- Environment Protection Act
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness

Module III :Fibonacci Numbers in nature (10 hrs)

The rabbit problem, Fibonacci numbers, recursive definition, Lucas numbers, Different types ofFibonacci 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 : Golden Ratio (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 : Human rights (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

Unit-3 Environment and Human Rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment, Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of Western ghats- mention Gadgil committee report, Kasthurirangan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

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
1	2	1	1	4
2	2	1	1	4
3	3	3	1	7
4	3	2	1	6
5	2	1	0	3
Total No of Questions	12	8	4	24
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course-9

Course Title	Real Analysis - 2
Course Code	19U6CRMAT09
Semester	6
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Books

1. Mathematical Analysis , 4thedition , S.C.Malik Savita arora

2. Elements of Real Analysis, S Chand, Shanti Narayan, Dr. M. D. Raisinghania.

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 improper integrals, Beta and Gamma functions.

5) 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, derivability and integrability of functions.	PO1/PSO2	U	F	20	0
CO2	Understand the concept of Riemann integration	PO1/PSO2	U	F,C	25	0
CO3	Understand improper integrals, beta and gamma functions	PO1/PSO2	U	F,C	25	0
CO4	Understand the concepts of convergence of sequence and series of functions	PO4/PSO4	U	F,P	20	0
	Total Number of Hours				90	0

Module 1 **(20 Hrs)**

Continuity and Differentiability:

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 , 2.1, 2.2, 2.3,2.4, 3, 4, 4.1.

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

Module - II **(25 Hrs)**

Riemann Integration :

Definition of Riemann integral , refinement of a partition , Darboux's theorem , conditions of integrability , integrability of sum , difference,product , quotient and modulus of integrable functions , integral as the limit of a sum ,some standard types of integrable functions , integration

and differentiation , Fundamental theorem of integral calculus , first mean value theorem , the generalised first mean value theorem, introduction of Riemann- Stieltjes integral

Text 1 : Chapter 9 , Sections , 1 ,1.1 ,1.2 ,2 ,3 ,4 ,5 ,5.1 ,6 ,7 , 8 ,9 ,10.1.,10.2 .

Chapter 10, Sections, 1 ,1.1 .

Module - III **(25 Hrs)**

Improper Integrals , Beta and Gamma Functions:

Integral of unbounded functions with finite limits of integration and their convergence, improper integrals with infinite range of integration, Beta and Gamma functions, properties of Gamma functions, extension of definition of Gamma functions, value of $\Gamma(1/2)$, transformation of Gamma function, symmetrical property of Beta function, transformation of Beta function, relation between Beta and Gamma functions.

Text 1 : Chapter 11 , Sections , 1 ,2 ,4

Text:2. Chapter 20 , Sections ,
20.1 ,20.2 ,20.3 ,20.4 ,20.5 ,20.6 ,20.7 ,20.8 ,20.9 ,20.10 ,20.11 ,20.12 .

Module IV **(20 Hrs)**

Sequences and Series of Functions :

Point wise convergence of a sequence of functions,uniform convergence of a sequence of functions on an interval, Cauchy's criterion for uniform convergence, tests for uniform convergence of a sequence of functions, Weierstrass's M- test for uniform convergence of a series of functions,Abel's test and Dirichlet's test for the uniform convergence of a series of functions**.**

Text 1 : Chapter 12 , Sections , 1 ,2 ,2.1 ,2.2 ,2.3 ,3 ,3.1 .3.2 .

References

1 Introduction to Real analysis, by Robert G Bartle and Donald R Sherbert, 3rd Edition, Wiley Student Edition

2 Methods of Real Analysis, by Richard R Goldberg, 3rd Edition ,Oxford and IBM publishing co. 1964.

3. Real analysis,by H.L.Royden, 3rd Edition., PHI .

4 A course of Mathematical analysis by Shanti Narayan S Chand and Co Ltd,2004.

5. Mathematical Analysis and its applications by J V Deshpande.

6. Mathematical Analysis Vol. 1, by Elias Zako ,Overseas press , New Delhi ,2006.

7 .Real analysis , by Chatterjee, PHI .

8 . Real Analysis ,by R A Gordon 2nd Edition. Pearson .

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
Total No. of Questions	12	8	4	24
No. of Questions to be answered	10	5	3	18
Total marks	20	25	30	75

Core Course -10

Course Title	Complex Analysis
Course Code	19U6CRMAT10
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 familiarising the student with the theory of functions of one complex variable, differentiability and analyticity of such 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		U	F,C	5	0

	conditions for differentiability	PO1/PSO2				
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 hours.)**

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: Analytic functions **(28 hours)**

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: Integrals **(25 hours)**

Derivatives of functions, definite integrals of functions, contours, contour integrals, some examples, upper bounds for moduli of contour integrals, antiderivates , Cauchy-Goursat theorem (without proof), simply and multiply connected domains, Cauchy’s integral formula, an extension of

Cauchy's integral formula, Liouville's theorem and fundamental theorem of algebra, maximum modulus principle.

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

Chapter 5 (Sections 55 to 60 and 62).

Module III: Series (15 hours)

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

Chapter 5 (Sections 55 to 60 and 62)

Module IV: Residues and poles (18 hours)

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, 2^{nd} 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
Total No of Questions	12	8	4	24
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course -11

Course Title	Linear Algebra and Graph Theory
Course Code	19U6CRMAT11
Semester	6
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 Graph Theory **(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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Core Course -12

Course Title	Fourier Series, Laplace Transforms and Metric Spaces
Course Code	19U6CRMAT12
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 teaching the students the concepts of Fourier Series, Fourier and Laplace Transforms and their applications in the physical world.The course also introduces the concept of metric spaces

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Find the Fourier transform of a given function.	PO1/PSO2	AP	F,P	25	0
CO2	Find the Laplace transform of a given function.	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 -Fourier Series **(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 Laplace Transforms **(25 hrs)**

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

(Sections 18.1 to 18.12 of text 1)

Module III **(15 hours)**

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

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

Module IV **(20 hours)**

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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

SYLLABUS OF

OPEN COURSE (APPLICABLE MATHEMATICS)

Course Title	Applicable Mathematics
Course Code	19U5OCMAT
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 preparing students of all streams, particularly those with arts and commerce back ground with the basics of mathematics required for their higher studies and preparing students of all streams, particularly those with arts and commerce back ground to approach competitive examinations. Detailed explanation and short cut method for solving problems are to be 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		U	F,P	18	0

	and Proportion and Percentage	PO1/PSO2				
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 – 1 **(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 – 2 **(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 – 3 **(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 – 4 **(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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

SYLLABUS FOR

MATHEMATICS (CHOICE BASED COURSE)

Choice Based Course - 1

Course Title	Operations Research
Course Code	19U6CRMAT13
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 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: **(20hrs.)**

Linear Programming:- Model formulation and solution by the Graphical Method and the Simplex method

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.)**

Duality in Linear Programming

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.)**

Transportation and Assignment Problems

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.)**

Theory of Games

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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Choice Based Course - 2

Course Title	Basic Python Programming and Typesetting in LaTeX
Course Code	19U6CRMAT14
Semester	6
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

Course structure

This course covers computer programming language using Python and document preparation using the LaTeX typesetting program. Since the operating system to be used is Ubuntu/Linux, fundamentals of this OS are also to be discussed. Python 3.x version with IDLE support should be used for introducing the concepts in Python programming. 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 University will conduct only theory examination, but Practical examination should be conducted internally and this should be considered for internal mark.

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		U	F,C	20	0

	including figures and tables using LaTex	PO1/PSO4				
	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 : Beginning Python Programming (16 hours)

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: Advanced features (20 hours)

Defining functions, Variables in functions, Advanced functions, Recursion, Lists, More featuresof 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: Beginning typesetting with using LaTeX (16 hours)

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: Typesetting Mathematics (20 hours)

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)

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. Dive Into Python by Mark Pilgrim, Free to download from URL

http://www.diveintopython.net/

4. LATEX , a Document Preparation System by Leslie Lamport (second edition, Addison Wesley, 1994).
5. 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
No. of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Choice Based Course - 3

Course Title	Numerical Analysis
Course Code	19U6CRMAT15
Semester	6
Credits	3
Contact Hours per week	4
Contact hours per semester.	72

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	PO1/PSO4	U	F,P	14	0
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 preliminaries, 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 1: 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
No. of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

SYLLABUS

OF COMPLEMENTARY COURSES IN MATHEMATICS

(B.Sc PHYSICS/ CHEMISTRY)

Complementary Course 1

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Find the extrema of functions of a single variable	PO1/PSO2	AP	P	8	0
CO2	Determine whether a given function is increasing or decreasing.	PO1/PSO2	AP	P	7	0
CO3	Understand functions of more than one variable	PO1/PSO2	U	P	5	0
CO4	Find partial derivatives of functions of more than one variable.	PO1/PSO2	AP	P	5	0
CO5	Find the extrema of functions of more than one variable.	PO1/PSO2	AP	P	5	0
CO6	Compute the area using integrals	PO1/PSO2	AP	C	42	0
	Total Number of Hours				72	0

Course Objectives :

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.

4) To get a brief idea of polar coordinates and their outcomes.

Course Outcomes:

Text Books: - 1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.

Module I

Applications of Derivatives: (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

Partial Derivatives: (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

Application of Integrals (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

Multiple Integrals (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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Complementary Course – 2

Course Title	Calculus II and Numerical Analysis
Course Code	19U2CPMAT02
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 Enginnering 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:

Module 1: **(20 hrs)**

Vector Differential Calculus

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	PO1/PSO2	AP	P	10	0
CO2	Understand the various properties of the gradient, the curl and divergence.	PO1/PSO2	U	P	10	0
CO3	Understand the applications of vector integration, in particular those of the Green's theorem, Stoke's theorem and divergence theorem..	PO1/PSO2	U	P	18	0
CO4	Understand finite differences and interpolation techniques.	PO1/PSO2	U	P	16	0
CO5	Use numerical methods to solve polynomial equations.	PO1/PSO2	AP	P	18	0
	Total Number of Hours				72	0

Velocity and Acceleration, Scalar and vector fields, Gradient of a scalar field,Geometrical Interpretation of Gradient, Directional Derivtive, 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)**

Integration on Vector fields

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

(Section 8.21 to 8.29 of text)

Module III **(16 hrs)**

Finite Difference and Interpolation

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)**

Numerical Solution of Algebraic Equations

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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Complementary Course - 3

Course Title	Differential Equations, Matrices and Trigonometry
Course Code	19U3CPMAT03
Semester	3
Credits	4
Contact Hours per week	5
Contact hours per semester.	90

Text Books

1) Ordinary and Partial Differential Equations with Laplace transforms, Fourier series and applications, by V Sundarapandian., McGraw Hill Publications

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

3) Plane Trigonometry by S. L Loney

Course Objectives :

The objectives of the course include familiarizing the student with the techniques of solving first order ordinary differential equations, the origin of first order p.d.e.’s and their solution. The course also introduces matrix theory and its application in solving systems of linear equations and applications of the Cayley Hamilton theorem. Basic trigonometry including summation of infinite series by the C+iS method is also introduced.

Course Outcomes:

CO	CO Statement	PO/ PSO	CL	KC	Class Hrs	Lab Hrs
CO1	Understand the methods of solving important types of first order ordinary differential equations.	PO1/PSO2	U	P	22	0
CO2	Understand the origin of first order p.d.e's and their solution.	PO1/PSO2	U	P	22	0
CO3	Understand different types of matrices and rank of a matrix	PO1/PSO2	U	P	6	0
CO4	Apply the concept of matrices in solving system of linear equations	PO1/PSO2	AP	P	6	0
CO5	Find the eigen values and eigen vectors of a given matrix	PO1/PSO2	AP	P	5	0
CO6	Understand the applications of Cayley Hamilton theorem	PO1/ PSO2	U	P	6	0
CO7	Understand trigonometric functions, their expansions and summation of infinite series using the C+iS method	PO1/ PSO2	U	P	23	0
	Total Number of Hours				90	0

Module I

Ordinary Differential Equations (22 hrs)

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

(Sections 2.1 to 2.7, 2.10, 2.11 of text 1)

Module II (22 hrs)

Partial Differential equations

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

(Sections 14.1 to 14.5 of text 1)

Module III (23 hrs)

Matrices

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 2

Module 1V (23 hrs)

Trigonometry

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)

(Relevant Sections in Chapter 3 – 5 and Chapter 8 of Text 3)

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
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

Complementary Course - 4

Course Title	Fourier Series, Laplace Transforms, Fourier Transforms, and Groups.
Course Code	19U4CPMAT04
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. Algebra, Abstract and Modern, by Swamy U.M , Murthy, Pearson publications

Course Objectives:

The objectives of the course include teaching the students the concepts of Fourier Series, Fourier and Laplace Transforms and their applications in the physical world.The course also introduces 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/PSO2	AP	P	23	0
CO2	Find the Fourier transform of a given function.	PO1/PSO2	AP	P	22	0
CO3	Find the Laplace transform of a given function.	PO1/PSO2	AP	P	23	0
CO4	Understand the concepts of groups, cyclic groups, permutation groups	PO1/PSO2	AP	P	22	0
	Total Number of Hours				90	0

Module 1 **(23 hrs)**

Fourier Series

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)**

Laplace Transforms

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 transforms

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)**

Groups

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

(Sections 3.1 to 4.4, 6.1to 6.4 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.

4) A First Course in Abstract Algebra, by John B Fraleigh, Seventh edition, 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 No of Questions	12	8	4	24
No.of questions to be answered	10	5	3	18
Total Marks	20	25	30	75

SYLLABUS FOR

MATHEMATICS COURSES OF

Bsc.COMPUTER APPLICATION AND

BCA COURSES

BSc. COMPUTER APPLICATIONS

SEMESTER 1

Course Code	19U1CRCMT1
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

to explain the fundamental ideas of sets and functions;

to introduce basic logic;

to introduce basic Number Theory

Course Outcomes

On completion of this course, successful students will be able to:

prove statements about sets and functions;

analyze statements using truth tables;

Construct simple proofs

Familiarize mathematical Symbols and standard methods of proofs.

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 1 **(15 hrs)**

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

(Text - 1 Chapter – 2)

Module 2 **(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 3 **(20 hrs)**

Basic Logic

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 4 **(17 hrs)**

Theory of Numbers

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) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	3	2	1
2	3	2	1
3	3	2	1
4	3	2	1
TOTAL	12	8	4

Semester 2

Course Code	19U2CRCMT2
Title of the course	Analytic Geometry, Theory of Equations and Numerical methods
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

to explain more ideas of conics;

Introduce theory of equations

Introduce numerical methods

Course Outcomes

On completion of this course, successful students will be able to:

find the equation to tangent, normal at a point on a conic ;

find the polar equation of a line, circle , tangent and normal to conics

Find the relation between roots and coefficient of polynomials

Text Books:

1. Manicavachagom Pillay , Natarajan – Analytic Geometry (Part I, Two Dimensions)

2. Engineering Mathematics, N.P. Bali, Manish Goyal, Lakshmi publications

MODULE I **(25hrs)**

Tangents and Normals (parametric form only) of a conic, Orthoptic locus. Pole and Polar. Chord in terms of given points. Conjugate diameters of ellipse and hyperbola. Asymptotes of a hyperbola, conjugate hyperbola and rectangular hyperbola. (Relevant sections of Text 1)

MODULE II (10hrs)

Polar co-ordinates, polar equation of a line, polar equation of a circle and polar equation of a conic. Polar equations of tangent and normal to these curves. (Relevant sections of Text 1)

MODULE III (18 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 2)

Module IV (19 hrs)

Finite Difference and Interpolation

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

(sections 22.1 to 22.11(d))

References

1.S.K . Stein – Calculus and analytic Geometry , (McGraw Hill)

2.A. N. Das – Analytic Geometry of two and three dimension (New Central Books)

3.Thomas and Finney - Calculus and analytical geometry (Addison-Wesley)

4. Quazi Shoeb Ahamad - Numerical and Statistical Techniques (Ane Books)

Question Paper Pattern

MODULE	Part A (2 Marks) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	4	2	1
2	3	2	1
3	3	2	1
4	2	2	1
TOTAL	12	8	4

Semester – 3

Course Code	19U3CRCMT3
Title of the course	Calculus
Semester in which the course is to be taught	3
No. of credits	4
No. of contact hours per week	5
Total Hours	90

Course Objectives

To explain reduction formulae in calculus

To know more about applications of integrals

To introduce double integral, triple integrals and its applications

To introduce partial differential equations

Course Outcomes

After completing this course the learner should be able to

Find the higher order derivative of the product of two functions.

Expand a function using Taylor's and Maclaurin's series.

Conceive the concept of asymptotes and obtain their equations.

Learn about partial derivatives and its applications.

Find the area under a given curve, length of an arc of a curve when the equations are given in parametric and polar form and find the area and volume by applying the techniques of double and triple integrals.

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 Differential Calculus **(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 derivatives 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

Partial Differentiation **(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

Integral Calculus **(20hrs.)** 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)

ModuleIV

Multiple Integrals. **(20 hrs.)** Double integrals, Areas, Double integrals in polar form, Triple integrals in rectangular coordinates, Triple integrals in cylindrical and spherical coordinates, substitutions in multiple integrals. (Text 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) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	3	2	1
2	3	2	1
3	3	2	1
4	3	2	1
TOTAL	12	8	4

Semester 3

Course Code	19U3CRCMT4
Title of the course	Vector Calculus, Trigonometry 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

Text Book:

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

2.S.L. Loney – Plane Trigonometry Part – II, S. Chand and Company Ltd.

Module 1 **(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 ∇ .

(Sections 8.10-8.20 of Text 1)

Module 2 **(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 3 **(20 hrs)**

Trigonometry

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,

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

(Relevant sections of Text 2- Chapter V,VI,VIII,IX)

Module IV **(25 hrs)**

Matrices:

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.Erwin Kreyszig : Advanced Engineering Mathematics, 8th ed., Wiley.

2. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

3.Shanti Narayan, P.K Mittal – Vector Calculus (S. Chand)

4.Merle C. Potter, J. L. Goldberg, E. F. Aboufadel – Advanced Engineering Mathematics (Oxford)

5.Ghosh, Maity – Vector Analysis (New Central books)

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

Question Paper Pattern

MODULE	Part A (2 Marks) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	4	2	1
2	3	2	1
3	2	2	1
4	3	2	1
TOTAL	12	8	4

Semester 4

Course Code	19U4CRCMT5
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

Course Outcomes

As outcomes of this course, the student must master the following

1) Obtain an integrating factor which may reduce a given differential equation into an exact one and eventually provide its solution.

2) Identify and obtain the solution of Clairaut's equation.

3) Find the complementary function and particular integrals of linear differential equation.

4) Familiarize the orthogonal trajectory of the system of curves on a given surface.

5) Method of solution of the differential equation $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$

6) Describe the origin of partial differential equation and distinguish the integrals of first order linear partial differential equation into complete, general and singular integrals.

7) Use Lagrange's method for solving the first order linear partial differential equation

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)

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 (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 :Partial Differential equations (20 hrs.)

Surfaces and Curves in three dimensions, solution of equation of the form $\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}$ Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange's method (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) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	3	2	1
2	3	2	1
3	3	2	1
4	3	2	1
TOTAL	12	8	4

Semester 5

Course Code	19U5CRCMT6
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

On the completion of the course, students should be able to

1) find the limit points of a set , the interior points of a set , closure of a set etc .

2) to test the convergence of a sequence and a series.

3) evaluate limits of functions .

4) study important theorems based on sequences and series

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 hours**

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 hours)**

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 hours)**

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, subsequences. (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 hours)**

Complex numbers

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

(Section 1 to 11 of chapter 1 of text 2.)

References

1 . Robert G Bartle and Donald R Sherbert, Introduction to Real analysis, 3rd edn.

2 . Richard R Goldberg , methods of analysis , 3rd edn , oxfoyd 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) Answer any 10	Part B (5marks) Answer any 5	Part C (10 marks) Answer any 3

1	4	2	1
2	4	2	1
3	3	3	1
4	1	1	1
Total	12	8	4

Semester 6

Course Code	19U6CRCMT7
Title of the course	Graph Theory and Numerical Analysis
Semester in which the course is to be taught	6
No. of credits	4
No. of contact hours per week	5
Total Hours	90

Course Objectives

1. To understand and apply the fundamental concepts in graph theory

2. To apply graph theory based tools in solving practical problems

3. To be efficient in using numerical methods

TextBook:

1.John Clark Derek Allen Holton - A first look at graph theory, Allied Publishers

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

Module I : Graph Theory (20 Hrs)

An introduction to graph. Definition of a Graph, Graphs as models, More definitions, Vertex Degrees, Sub graphs, Paths and cycles The matrix representation of graphs (definition & example only)

(Section 1.1 to 1.7 of text 1)

Trees and connectivity. Definitions and Simple properties, Bridges, Spanning trees, Cut vertices and connectivity. (Section 2.1, 2.2, 2.3 & 2.6 of text 1)

Module 2 (25 hrs)

Euler Tours and Hamiltonian Cycles .Euler's Tours, The Chinese postman problem .Hamiltonian graphs, The travelling salesman problem, Matching and Augmenting paths, Hall`s Marriage

Theorem (statement only), The personnel Assignment problem, The optimal Assignment problem (Section 3.1(algorithm deleted) 3.2(algorithm deleted), 3.3, 3.4 (algorithm deleted)) Matching (Section 4.1,4.2 4.3(algorithm deleted),4.4 (algorithm deleted) of text 1)

Module 3 **(20 hrs)**

Numerical Solution of Algebraic Equations

Graphical Method, Bisection method, Iteration method, Newtons iteration method, Regula falsi method, Horner's method, Graeffe's root squaring method

Text 2 : Sections 22.16 to 22.16(g)

Module 4 **(25 hrs)**

Solution of Simultaneous Algebraic Equations

Gauss Elimination Method, Gauss-Jordan Method, Method of Factorisation or Triangularisation, Crout's Method, Iterative Methods, Jacobi Method of Iteration or Gauss-Jacobi Method, Gauss-Seidel Iterative Method

Text 2 : Sections 22.17 to 22.18(b)

References

1. Douglas B West Peter Grossman - Introduction to Graph Theory

2. W.D.Wallis - A Beginner's Guide to Discrete Mathematics, Springer

3. R. Balakrishnan, K. Ranganathan - A textbook of Graph Theory, Springer International Edition

4. S.Arumugham, S. Ramachandran - Invitation to Graph Theory, Scitech. Peter Grossman

Question Paper Pattern

MODULE	Part A (2 Marks) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	4	2	1
2	4	2	1
3	2	2	1
4	2	2	1
TOTAL	12	8	4

B.C.A

SEMESTER 1

Course Code	19U1CRCMT1
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

to explain the fundamental ideas of sets and functions;

to introduce basic logic;

to introduce basic Number Theory

Course Outcomes

On completion of this course, successful students will be able to:

prove statements about sets and functions;

analyze statements using truth tables;

Construct simple proofs

Familiarize mathematical Symbols and standard methods of proofs.

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 1 **(15 hrs)**

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

(Text - 1 Chapter – 2)

Module 2 **(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 3 **(20 hrs)**

Basic Logic

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 4 **(17 hrs)**

Theory of Numbers

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) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	3	2	1
2	3	2	1
3	3	2	1
4	3	2	1
TOTAL	12	8	4

SEMESTER 2

Course Code	19U1CRCMT2
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

to explain the fundamental ideas of complex numbers;

to introduce basic Number Theory;

to introduce basic logic

to introduce graph theory concepts

Course Outcomes

On completion of this course, successful students will be able to:

do algebraic operations using complex numbers

solve number theory problems

analyze propositions;

use algorithms to solve problems in daily life .

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) , Mc.Graw Hill.

MODULE I: Complex Numbers (17 hrs)

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

MODULE II: Combinatorics (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: Propositional Calculus (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: Graphs and Algorithms (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) Answer any 10	Part B (5 Marks) Answer any 5	Part C (10 Marks) Answer any 3
1	3	2	1
2	3	2	1
3	3	2	1
4	3	2	1
TOTAL	12	8	4