SACRED HEART COLLEGE (AUTONOMOUS), THEVARA

KOCHI, KERALA, 682013

CURRICULUM AND SYLLABI

CHOICE BASED COURSE CREDIT AND SEMESTER SYSTEM

(CBCSS)

BSC MATHEMATICS PROGRAMME

INTRODUCED FROM 2015 ADMISSION ONWARDS

BOARD OF STUDIES IN MATEMATICS

Sacred Heart College, Thevara, Kochi, Kerala

SACRED HEART COLLEGE AUTONOMOUS THEVARA, KOCHI-682013 1944

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CURRICULUM

1.1 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 "mathematics" which comes from a Greek word meaning "inclined to learn". 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 study of numbers and their various 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.

Bachelor of Science (B.Sc) (Hons) in Mathematics provides in-depth knowledge geometry, trigonometry, calculus and various other theories in Mathematics or related discipline such as Computer Science or Statistics. Mathematics Hons course is an important and valuable one that provides opportunities to the students of taking some subjects of Master's deree.

Applicable to all regular Under Graduate Programmes conducted by the Sacred Heart College (Autonomous) with effect from 2015-16 admissions.

1.2 STUDENT ATTRIBUTES

- Give 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 modeling, solving and interpreting
- Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
- Enhancing students' overall development and to equip 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 them many aspects of Mathematical Sciences.

1.3 DEFINITION.

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

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

1.3.4 '*Academic Week'* is a unit of five working days in which distribution of work is organized from day-one today-five, with five contact hours of one hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.

1.3.5.'*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.

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

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

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

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

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

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

1.3.12. '*Additional credit'* is the numerical value assigned to Club activities, Social service, Internship etc. which is not added with the total academic credits of the students.

1.3.13. '***Internship'*** is job training for professional careers.

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

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

1.3.16.'***Parent Department'*** means the department which offers core courses within a degree

programme.

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

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

1.3.19. '*Faculty Advisor'* means a teacher from the parent department nominated by the Department Council, who will advise the student in the choice of his/her courses and other academic matters.

1.3.20. Grace Marks shall be awarded to candidates as per the University Orders issued from time to time.

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

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

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

1.4. DURATION

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

The duration of odd semesters shall be from **June to October** and that of even semesters from **November to March.**

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

1.5. REGISTRATION

The strength of students for each course shall remain as per existing regulations, except in case of open courses for which there shall be aminimum of 15 and maximum of 75 students per batch, subject to a marginal increase of 10. For non-core compulsory courses the student strength shall be decided by the Academic Council of the College from time to time.

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

1.6.SCHEME AND COURSES

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 English copy editor.

I) 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).

1.7. PROGRAMME STRUCTURE FOR MODEL-I

A	Programme Duration	6 Semesters
B	Minimum credits required from common courses	38
C	Minimum credits required from Core + complementary + vocational* courses including Project	79
D	Minimum credits required from Open course	03
E	Additional core course (Environmental studies)	04
	Total Credits required for successful completion of the programme	124

F	Club activity (desirable)	01
G	Social service (mandatory)	01
H	Internship (desirable)	02

1.8. EXAMINATIONS.

The evaluation of each course shall contain two parts:

(i) CONTINUOUS INTERNAL ASSESSMENT (CIA)

(ii) END-SEMESTER EXAMINATION (ESE)

The internal to external assessment ratio shall be 1:3, for both courses with or without practical. There shall be a maximum of 75 marks for external evaluation and maximum of 25 marks for internal evaluation.

1.9. Computation of Grade and Grade points.

For all courses (theory & practical), grades are given on a 07-point scale based on the total percentage of marks. ***(CIA+ESE)*** as given below

Percentage of Marks	**Grade**	**Grade Point**
90 and above	A+ - Outstanding	10
80-89	A - Excellent	9
70-79	B - Very Good	8
60-69	C - Good	7
50-59	D - Satisfactory	6
40-49	E - Adequate	5
Below 40	F - Failure	0

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

1.9.1 Computation of SGPA

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses and the sum of the number of credits of all the courses undergone by a student in a semester.

SGPA (Si) = $\sum(C_i \times G_i) / \sum C_i$

Where C_i is the number of credits of the ith course and G_i is the grade point scored by the student in the ith course.

1.9.2 Computation of CGPA

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

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

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

Note: The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

Illustration of Computation of SGPA and CGPA and Format for Transcripts

i. Computation of SGPA and CGPA

Illustration for **SGPA**

Course	**Credit**	**Grade letter**	**Grade point**	**Credit Point** (Credit x Grade
Course 1	3	B	8	3 X 8 = 24
Course 2	4	C	7	4 X 7 = 28
Course 3	3	D	6	3 X 6 = 18
Course 4	3	A^+	10	3 X 10 = 30

Course 5	3	E	5	3 X 5 = 15
Course 6	4	D	6	4 X 6 = 24
	20			139

Thus, **SGPA =139/20 =6.95**

Illustration for **CGPA**

Semester 1	**Semester 2**	**Semester 3**	**Semester 4**
Credit : 20 SGPA:6.9	Credit : 22 SGPA:7.8	Credit : 25 SGPA: 5.6	Credit : 26 SGPA:6.0
Semester 5	**Semester 6**		
Credit : 26 SGPA:6.3	Credit : 25 SGPA: 8.0		

Thus, **CGPA** = $\frac{20 \times 6.9 + 22 \times 7.8 + 25 \times 5.6 + 26 \times 6.0 + 26 \times 6.3 + 25 \times 8.0}{144}$ = **6.73**

Grades for the different semesters and overall programme are given based

On the corresponding SGPA/ CGPA as shown below:

SGPA/*CGPA*	**Grade**
Above 9	***A+ - Outstanding***
Above 8, but below or equal to 9	***A - Excellent***
Above 7, but below or equal to 8	***B -Very Good***
Above 6, but below or equal to 7	***C – Good***
Above 5, but below or equal to 6	***D – Satisfactory***
Above 4, but below or equal to 5	***E – Adequate***

4 or below	***F – Failure***

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 40% are required for a pass for a course.

For a pass in a programme, a separate minimum of Grade E is required for all the individual courses. If a candidate secures **F** Grade for any one of the courses offered in a Semester/Programme only **F** grade will be awarded for that Semester/Programme until he/she improves this to **E** grade or above within the permitted period. Candidate secure **E** grade and above will be eligible for higher studies.

1.10. Detailed Distribution of Courses

Choice-based Credit and Semester System: BSc (Mathematics) Programme – Model I

Semester	Title of the Course	Hours per Week	Credit	Marks(Total 100)	
				Internal	External
I	English I	5	4	25	75
	English Common I	4	3	25	75
	Second Language I	4	4	25	75
	Core course-1	4	3	25	75
	Complementary I Physics-1	4	3	25	75
	Complementary II Statistics-1	4	3	25	75
II	English II	5	4	25	75
	English Common II	4	3	25	75
	Second Language II	4	4	25	75

	Core course -2	4	3	25	75
	Complementary I Physics-2	4	3	25	75
	Complementary II Statististics-2	4	3	25	75
	Additional core course (Environmental studies)	4	4	25	75
III	English III	5	4	25	75
	Second Language Common I	5	4	25	75
	Core course -3	5	4	25	75
	Complementary I Physics -3	5	4	25	75
	Complementary I Statistics-3	5	4	25	75
IV	English IV	5	4	25	75
	Second Language Common II	5	4	25	75
	Core course -4	5	4	25	75
	Complementary I Physics-4	5	4	25	75
	Complementary II Statistcs-4	5	4	25	75

Semester	Title of the Course	Hours per Week	Credit	Weightage	
				Internal	External
V	Core course -5	5	4	25	75

	Core course -6	6	5	25	75
	Core course -7	5	4	25	75
	Core course -8	5	4	25	75
	Open Course*	4	3	25	75
VI	Core course -9	5	4	25	75
	Core course -10	5	4	25	75
	Core course -11	5	4	25	75
	Core course -12	5	4	25	75
	Core course -13	4	3	25	75
	Project	1	1	25	75
	TOTAL	154	124		

* One course to be selected from the list of Open Courses.

B.Sc Programme in Mathematics (Core Courses):

The following table shows the structure of the programme which indicates Code of the courses, title of the courses, instructional hours, credits, university examination style and the components for internal and external evaluation.

Details Mathematics (Core Courses)

Semester	Title of the Course	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Weightage	
						IA	EA
1	15U1CRMAT1-**Foundation of Mathematics**	4	3	72	3 hrs	25	75
2	15U2CRMAT2 –**Analytic Geometry ,Trigonometry and Matrices**	4	3	72	3	25	75
3	15U3CRMAT3 – **Calculus**	5	4	90	3	25	75
4	15U4CRMAT4– **Vector Calculus, Theory of Equations and Numerical Methods**	5	4	90	3	25	75
5	15U5CRMAT5 – **Mathematical Analysis**	5	4	90	3	25	75
	15U5CRMAT6 – **Differential Equations**	6	5	108	3	25	75
	15U5CRMAT7 – **Abstract Algebra**	5	4	90	3	25	75
	15U5CRMAT8 – **Fuzzy mathematics**	5	4	90	3	25	75
	– **Open course**	4	3	72	3	25	75
6	15U6CRMAT9 – **Real Analysis**	5	4	90	3	25	75
	15U6CRMAT10 – **Complex Analysis**	5	4	90	3	25	75
	15U6CRMAT11 – **Discrete Mathematics**	5	4	90	3	25	75

6	15U6CRMAT12 – **Linear Algebra and Metric Spaces**	5	4	90	3	25	75
	15U6CRMAT13 **– Choice Based Course**	4	3	72	3	25	75
	Project	1	1	18	-	25	75

COMPLEMENTARY COURSES:

Mathematics for B.Sc Physics / Chemistry

Semester	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	University Exam Duration	Weightage	
						IA	EA
1	15U1CPMAT1 – **Differential Calculus and Trigonometry**	4	3	72	3 hrs	25	75
2	15U2CPMAT2– **Integral Calculus and Matrices**	4	3	72	3	25	75
3	15U3CPMAT3 – **Vector Calculus , Differential Equations and Analytic Geometry**	5	4	90	3	25	75
4	15U4CPMAT4- **Fourier Series , Differential Equations, Numerical Analysis and Abstract Algebra**	5	4	90	3	25	75

Open Course

(For those students who have not studied mathematics as Complementary or Core)

Code	Title of the Course	No. of contact hrs/week	No. of Credit	Duration of Exam
15U5OCMAT1	**Applicable Mathematics**	4	3	3 hrs

Total credits for core and complementary - 79

Additional core course 4

Open - 3

86

Total credits for English and second language- 38

Total 124

1.11. MARKS DISTRIBUTION FOR EXTERNAL EXAMINATION AND INTERNAL EVALUATION

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

Components of the internal evaluation and their marks are as below.

For all courses without practical

a) Marks of external Examination : 75

b) Marks of internal evaluation : 25

All the three components of the internal assessment are mandatory. For common course English in I Semester, internal oral examination shall be conducted instead of test paper.

Components of Internal Evaluation	**MARKS**
Attendance	**5**
Assignment (Written assignments, preparation of models, charts, posters etc., field survey, field work)	**5**
Seminar/Viva	**5**
Test papers-2	**10**
Total	**25**

Project Evaluation: (Max. marks100)

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

Attendance Evaluation

For all courses without practical

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

75	1

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

1.12. CONDONATION OF SHORTAGE OF ATTENDANCE

Candidate can seek condonation of shortage of attendance only once in a 2 year course and twice in other courses of longer duration. Following are the rules regarding attendance requirement:-

1. Every candidate is to secure 75% attendance of the total duration of the course.

2. A candidate having a shortage of 10% can apply for condonation of shortage in prescribed form on genuine grounds. Condonation of shortage of attendance if any should be obtained at least 7 days before the commencement of the concerned semester examination.

3. It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned course teacher and HoD.

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

2

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,acoordinator 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 concerned Faculty, HOD of concerned department and one member of the Academic council nominated by the principal every year as members.

PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/She shall also submit a detailed scheme of evaluation along with the question paper.

A question paper shall be a judicious mix of objective type, short answer type, short essay type /problem solving type and long essay type questions.

Pattern of questions for external examination for theory paper without practical.

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
Part A	10	10	1	10
Part B	10	8	2	16
Part C	7	5	5	25
Part D	4	2	12	24
TOTAL	**31**	**25**		**75**

3

Syllabi

Syllabi for Core

MODEL - I

BSc.Programme in Mathematics

Core Course - 1

Course Code	15U1CRMAT01
Title of the course	Foundation of Mathematics
Semester in which the course is to be taught	I
No. of credits	3
No. of contact hours per week	4
Total Hours	72

4.1. COURSE AIM/RATIONALE.

- to explain the fundamental ideas of sets and functions;
- to introduce basic logic;
- to introduce basic Number Theory

4.2. OBJECTIVES OF THE COURSE.

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.

4.3. COURSE DESIGN

Module (1)	15 **HOURS**
Module (2)	**20 HOURS**
Module (3)	20 **HOURS**
Module (4)	17 **HOURS**

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 hours)**

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

(Text - 1 Chapter - 2)

Module 2 **(20 hrs)**

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

Pre-requisite: Nil.

Syllabus: 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 Theory of Numbers **(17 hrs)**

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

(Text – 2 , Chapter – 1 and 26)

References :

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

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

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

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

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

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

7. Richard Johnsonbaugh – Discrete Mathematics (Pearsons)

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

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

QUESTON PAPER PATTERN

Module	**Part A (1mark)**	**Part B (2 marks)**	**Part C (5marks)**	**Part D (12 marks)**
I	2	2	1	**1**
II	3	3	2	1
III	2	2	2	1
IV	3	3	2	1
Total	**10**	**10**	**7**	**4**

Core Course - 2

Course Code	15U1CRMAT02
Title of the course	Analytic Geometry, Trigonometry and Matrices
Semester in which the course is to be taught	II
No. of credits	3
No. of contact hours per week	4
Total Hours	72

COURSE AIM/RATIONALE.

- to explain more ideas of conics;
- to introduce circular and hyperbolic function of complex variables
- to explain rank of a matrix, characteristic roots and characteristic vectors

OBJECTIVES OF THE COURSE

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
- familiarize real and imaginary parts of a circular and hyperbolic functions of a complex variable
- solve a System of Linear equations using the inverse of a matrix
- familiarize characteristic roots and characteristic vectors.
- To find the inverse of a matrix by Cayley-Hamilton theorem

Syllabus

Text books:

1. Manicavachagom Pillay , Natarajan – Analytic Geometry (Part I, Two Dimensions)
2. S.L. Loney – Plane Trigonometry Part – II, S. Chand and Company Ltd.
3. Frank Ayres Jr - Matrices , Schaum's Outline Series, TMH Edition.

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 **(10 hrs)**

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

Trigonometry **(17 hrs)**

Circular and hyperbolic functions of a complex variable. Separation into real and imaginary parts. Factorisation of x^n-1, x^n+1, $x^{2n} - 2x^n a^n \cos n\theta + a^{2n}$. Summation of infinite series by C + i S method

(Relevant sections of Text 2, Chapter – V , VII , IX)

MODULE IV

Matrices **(20 hrs)**

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Equivalent matrices, Row Canonical form, Normal form, Elementary matrices only.

Systems of Linear equations: System of non homogeneous, solution using matrices, Cramer's rule, system of homogeneous equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only) and simple applications

(Text 3, Chapters – 5, 10, 19, 23).

Reference Books:

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

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	4	3	2	1
II	1	1	1	1
III	3	3	2	1
IV	2	3	2	1
Total	**10**	**10**	**7**	**4**

Core Course - 3

Course Code	15U1CRMAT03
Title of the course	Calculus
Semester in which the course is to be taught	III
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

- **To explain reduction formulae in calculus**
- **To more about applications of integralst**
- **To introduce double integral, triple integrals and its applications**
- **To introduce partial differential equations**

Objectives

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.

Find the area and volume by applying the techniques of double and triple integrals

Syllabus

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 (30 hrs.)

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 (20 hrs.)

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

(Text 1 Section 5.6, 6.1, 6.2, 6.3, 6.5)

Module IV

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)

Reference:

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.

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	2	2	1
II	2	3	1	1
III	3	2	2	1
IV	2	3	2	1
Total	**10**	**10**	**7**	**4**

Core Course - 3

Course Code	15U4CRMAT04
Title of the course	Vector Calculus, Theory of Equations and Numerical methods
Semester in which the course is to be taught	IV
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

- **To explane integration of vector functions**
- **Introduce theory of equations**
- **Introduce numerical methods**

Objectives

After completing this course the learner should be able to

- Find roots of algebraic and transcendental equation using numerical methods
- **Find the relation between roots and coefficient of polynomials**
- **Integrate vector values functions**

Text Books:

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.
2. Bernard and Child - Higher Algebra, AITBS Publishers, India
3. S.S. Sastry - Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Module I

(A quick review) **(20 hrs)**

Lines and planes in space., Cylinders and Quadric surfaces, Vector functions Arc length and Unit tangent vector, Curvature and Unit normal vector, torsion and Unit Binormal vector, Directional derivatives and gradient vectors , tangent planes and Differentials
(Sections 12.5 ,12.6 , 13.1 , 13.3 , 13.4 , 13.5 , 14.5 , 14.6 of Text 1)

Module II

Integration in Vector Fields **(30 hours)**

Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields, Green's theorem in the plane, Surface area and surface integrals, Parameterized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).
(Sections 16.1 to 16.8 of Text 1)

Module III

Theory of Equations **(25 hours)**

Statement of fundamental Theorem of algebra. Deduction that every polynomial of degree n has n and only n roots. Relation between roots and coefficients. Transformation of equations. Reciprocal equations. Cardan's method, Ferrari's method. Symmetric functions of roots.
(Chapter 6 and Descartes Rule of signs also, 11 , 12 of Text 2)

Module IV

Introductory Methods of Numerical Solutions **(15 hours)**

Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method
(Sections 2.2, 2.3, 2.4, & 2.5 of Text 3)

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

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	0
II	3	3	2	2
III	2	2	2	1
IV	2	2	1	1
Total	10	10	7	**4**

Core Course - 5

Course Code	15U5CRMAT05
Title of the course	**MATHEMATICAL ANALYSIS**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

- **To introduce the**

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, intimum. 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

complex numbers **20 hours**

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. Foots 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 edition.Wiley
2. Richard R Goldberg – Methods of real analysis 3rd edition , Oxford and IBM Publishing Co (1964)
3. Shanti Narayan – A Course of mathematical analysis , S Chand and Co Ltd(2004)
4. Elias Zako – Mathematical analysis Vol1, Overseas Press, New Delhi(2006)
5. J. M .Howie – Real Analysis, Springer 2007
6. K.A Ross - Elementary Real Analysis, Springer, Indian Reprint
7. M.R Spiegel – Complex Variables, Schaum's Series

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	2	2	1	1
II	3	3	2	1
III	3	3	3	2
IV	2	2	1	-
Total	**10**	**10**	**7**	**4**

Core Course - 6

Course Code	15U5CRMAT06
Title of the course	**DIFFERENTIAL EQUATIONS**
Semester in which the course is to be taught	V
No. of credits	5
No. of contact hours per week	6
Total Hours	108

COURSE AIM/RATIONALE.

- Obtain an integrating factor which may reduce a given differential equation into an exact one and eventually provide its solution.
- Identify and obtain the solution of Clairaut's equation.
- Fine the complementary function and particular integrals of linear differential equation.
- Familiarize the orthogonal trajectory of the system of curves on a given surface.
- Method of solution of the differential equation $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$
- Describe the origin of partial differential equation and distinguish the integrals of first order linear partial differential equation into complete, general and singular integrals.
- 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

Ordinary differential equations (25 hrs.)

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

(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)

Method IV :

Partial Differential equations (20 hrs.)

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

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

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

Reference: Reference:

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) . Murrary –.Differential Equations. Macmillian
7. E.A. Coddington - An Introduction to Ordinary Differential Equation, PHI.
8. Sankara Rao - Introduction to Partial Differential Equation,2nd edition, PHI.
9. Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	1
II	3	3	2	1
III	2	2	2	1
IV	2	2	1	**1**
Total	**10**	**10**	**7**	**4**

Core Course - 7

Course Code	15U5CRMAT07
Title of the course	**ABSTRACT ALGEBRA**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

Text book :

John B.Fraleigh - A first course in Abstract Algebra (3rd Edition),
(Chapters 1-7 ,11-13 , 23, 24 and 28)

Module 1 **(25 hours)**

Binary operation-Groups,Definition and elementary properties-finite groups and group tables-subsets and sub groups-cyclic sub groups-functions and permutations- groups of permutations-examples.Cycles and Cyclic notations-even and odd permutations-the alternating groups.

Module 2 **(25 hours)**

Cyclic Groups-Elementary Properties-Classification of cyclic groups-Subgroups of finite cyclic groups-Isomorphisms-Definition and elementary properties-How to show that two groups are isomorphic(Not Isomorphic)-Cayle's Theorem-Groups of Cosets--Applications-Criteria for the existence of a coset group-inner automorphisms and normal subgroups-Factor groups-Simple groups

Module 3 **(20 hours)**

Homomorphism-Definition and Elementary Properties-The Fundamental Homomorphism theorem-Applications. Rings,Definition and Basic Properties-Multiplicative questions;Fields-Integral Domains-Divisors of Zero And Cancellation-Integral Domains.

Module 4 **(20 hours)**

Characteristic of a Ring- Quotient Ring and Ideals-Criteria For The Existence of a Coset Ring-Ideals And Quotient Rings.

References :

1. I.N Herstein - Topics in Algebra
2. Joseph A Gullian - A Contemporary Abstract Algebra,Narosa Pub.House .
3. Hillbert – Algebra
4. Artin – Algebra , PHI
5. P.B Bhattacharya , S. K Jain and S. R . Nagpaul – Basic Abstract Algebra , 2nd edition, Cambridge University Press
6. Durbin – Modern Algebra , An introduction , 5th edition , Wiley
7. Chatterjee - Abstract Algebra , 2nd edition, PHI
8. M. K. Sen, S. Ghosh - Topics in Abstract Algebra (University Press)

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	1
II	3	3	2	1
III	2	2	2	1
IV	2	2	1	**1**
Total	**10**	**10**	**7**	**4**

Core Course - 8

Course Code	15U5CRMAT08
Title of the course	**FUZZY MATHEMATICS**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

Text Book:

George J. Klir and BoYuan, - *Fuzzy Sets and Fuzzy Logic Theory and Applications'*, Prentice Hall of India Private Limited New Delhi, 2000.

Module - I **(20 Hrs)**

Introduction , Crisp Sets: An Overview ,Fuzzy Sets: Basic Types ,Fuzzy Sets: Basic concepts. Additional properties of α cuts, Representation of fuzzy sets, Extension principle of fuzzy sets. (Chapter 1 – 1.1, 1.2, 1.3 and 1.4 and Chapter 2– 2.1 , 2.2 , 2.3)

Module - II

Operations on Fuzzy Sets: **(30 Hrs)**

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

Module - III

Fuzzy Arithmetic **(20 Hrs)**

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

Module - IV

Fuzzy Logic **(20 Hrs)**

Classical Logic: An Overview , Multivalued Logics , Fuzzy propositions , Fuzzy quantifiers ,Linguistic Hedges, Inference from Conditional Fuzzy propositions ,
Chapter 8 – 8.1, 8.2, 8.3, 8.4, 8.5 and 8.6 only)

Reference:

1. Klir, G. J and T. Folger, *Fuzzy Sets, Uncertainty and Information*, Prentice Hall of India Private Limited New Delhi, (1988)
2. H.J Zimmermann, *Fuzzy Set Theory- and its Applications*, Allied Publishers, 1996.
3. Dubois, D and H. Prade , *Fuzzy Sets and System: Theory and Applications*, Academic Press, New York, 1988
4. Abraham Kandel, *Fuzzy Mathematical Techniques with Applications*, Addison – Wesley Publishing Company 1986

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	-

II	3	3	2	2
III	2	2	2	1
IV	2	2	1	**1**
Total	**10**	**10**	**7**	**4**

Core Course - 9

Course Code	15U5CRMAT09
Title of the course	REAL ANALYSIS
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

Text book:

S.C.Malik and Savitha Arora - mathematical Analysis, 2nd Edition.

Module I :

Infinite Series **20 hours**

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

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

Module II :

Continuous functions **25 hours**

Continuous function (a quick review). Continuity at a point, continuity in an interval. Discontinuous functions. Theorems on continuity. Functions continuous on closed intervals. Uniform continuity.
(Section 2.1 to 2.4 ,3,4 of chapter 5 of Text 1)

Module III :

Riemann Integration **30 hours**

Definitions and existence of the integral. Inequalities of integrals. Refinement of partitions of integrability. Integrability of the sum of integrable functions. The integrals as the limit of a sum. Some applications. Some integrable functions. Integration and differentiation. The fundamental theorem of calculus.
(Section 1 to 9 of chapter 9 of Text 1)

Module IV :

Uniform Convergence **15 hours**

Point wise convergence. Uniform convergence on an interval. Cauchy`s criterion for uniform convergence. A test for uniform convergence of sequences. Test for uniform convergence of series. Weierstrass`s M-test, Abel`s test. Statement of Dirichelet`s test without proof.
(Section 1 to 3.2 of Text 1)

References:

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

7. Nanda, Saxena – Real Analysis (Allied)

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	1
II	2	2	2	1
III	3	3	2	1
IV	2	2	1	1
Total	**10**	**10**	**7**	**4**

Core Course - 10

Course Code	15U5CRMAT10
Title of the course	COMPLEX ANALYSIS
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

The course aims:

- To explain the fundamental ideas of Analytic functions
- To discuss basic methods of complex integration
- To introduce elementary complex functions
- To discuss power series expansion of analytic functions

Text book:

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

Module 1 **(30 hours)**

Analytic functions

Functions of a complex variable-limits-theorems on limits-continuity-derivatives-differentiation formulas-Cauchy-Riemann equations-sufficient condition for differentiability-analytic functions examples-harmonic functions.

Elementary functions

Exponential function –logarithmic function –complex exponents –trigonometric functions-hyperbolic functions- inverse trigonometric and hyperbolic functions.

Module 2 **(25 hours)**

Integrals

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

Module 3 **(15 hours)**

Series

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

Module 4 **(20 hours)**

Residues and poles

Isolated singular points –residues –Cauchy's residue theorem –three types of isolated singular points-residues at poles-examples –evaluation of improper integrals-example –improper integrals from Fourier analysis –Jordan's lemma (statement only) –definite integrals involving sines and cosines.

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Chapter2-sections12,15,16,18to22,24,25,26.
Chapter3-sections29,30,33to36.
Chapter4-sections37to41,43,44,46,48to54.
Chapter5-sections55to60&62.
Chapter6-sections68to74(except71).
Chapter7-sections78to81&85.

Reference:

1. Lars V.Ahlfors - Complex Analysis – An Introduction to the Theory of Analytic Functions of one Complex Variables (4th edition), (McGRAW-HILL)
2. Shanti Narayan - Theory of functions of a complex variable
3. Kasana - Complex Variables: Theory and Applications , 2nd edition
4. B. Choudhary - The Elements of Complex Variables.
5. A. David Wunsch – Complex Analysis with Applications (Pearson)

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	1
II	3	3	2	1
III	1	2	1	1
IV	3	2	2	1
Total	**10**	**10**	**7**	**4**

Core Course - 11

Course Code	15U5CRMAT11
Title of the course	DISCRETE MATHEMATICS
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours per week	5

Total Hours	90

COURSE AIM/RATIONALE.

Text books:

1. John Clark Derek Allen Holton - A first look at graph theory, Allied Publishers
2. David M Burton - Elementary Number Theory 6th Edition TMH
3. Vijay K. Khanna - Lattices and Boolean Algebras- First Concepts, Vikas Publishing House Pvt Ltd.

Module I :

Graph Theory **(40Hrs)**

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 **(20 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:

Introduction to Cryptography **(15 Hrs)**

From Caesar Cipher to Public key Cryptography, the Knapsack Cryptosystem
(Section 10.1, 10.2 only of text 2)

Module 4:

Poset and Lattices **(15 Hrs)**

Diagramatical Representation of a Poset, Isomorphisms, Duality, Product of two Posets, Lattices, Semilattices, Complete Lattices, Sublattices.

(Chapter 2 of text 3)

Reference:

1. Douglas B West Peter Grossman - Introduction to Graph Theory
2. W.D.Wallis - A Biginner'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,
5. J.K Sharma - : Discrete Mathematics(2^{nd} edition), (Macmillion)
6. S. A. Choudam –A First Course in Graph Theory (Macmillian)
7. Theory (Macmillian)

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	3	1
II	3	3	2	1
III	2	2	1	1
IV	2	2	1	1
Total	10	10	7	4

Core Course - 12

Course Code	15U5CRMAT12

Title of the course	LINEAR ALGEBRA AND METRIC SPACES
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

Text Book :

1. Richard Bronson, Gabriel B. Costa - Linear Algebra An Introduction (Second Edition), Academic Press 2009, an imprint of Elsevier.
2. G. F. Simmons -- Introduction to Topology and Modern analysis (Tata Mc Graw Hill)

Module 1 **(25 hours)**

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 2

(30 hours)

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 3

(15 hours)

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

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

Module 4 **(20 hours)**

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

(Chapter: -2 ,Sections 12, 13)

Reference:

1 I. N. Herstein – Topics in Algebra , Wiley India

2 Harvey E. Rose - Linear Algebra, A Pure Mathematical Approach, Springer

3 Devi Prasad, - Elementary Linear Algebra, Narosa Publishing House

4 K. P. Gupta – Linear Algebra, Pragathi Prakashan

5 Promode Kumar Saikia – Linear Algebra, Pearson

6 Derek J. S. Robinson – A Course in Linear Algebra with Applications, Allied.

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	1
II	3	3	2	1
III	2	2	2	1
IV	2	2	1	**1**
Total	**10**	**10**	**7**	**4**

Core Course - 13

Course Code	15U5CRMAT13
Title of the course	OPERATIONS RESEARCH
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

- Define a Euclidean space, a vector space and its basis.
- Write a given LPP in standard form and in a canonical form
- Identify a feasible solution, a basic feasible solution, and an optimal solution using simplex method.
- Identify the Transportation Problem and formulate it as an LPP and hence solve the problem
- Determine that an Assignment problem is a special case of LPP and hence solve by Hungarian method.
- Identify the queueing models.

Text Books:

1. K. V Mital and C. Mohan - Optimization Methods in Operations Research and System Analysis (3rd edition) (New Age International)
2. J. K. Sharma : Operation Research Theory and Application (3rd edition)

Module 1

Mathematical Preliminaries **(10 hrs)**

Euclidean Space : Vectors and vector space Linear dependence, dimensions of a vector space, basis.

Convex sets : Open and closed sets in E_n, convex linear combinations, convex sets, intersection of convex sets, convex hull of a set, vertices of a convex set, convex polyhedron, hyper planes, half spaces and polytopes, separating and supporting hyper planes, (All Theorems without proof)

Linear Programming **(10 hrs)**

Introduction, LP in two dimensional space, general LPP, Feasible solution, Basic and basic feasible solution, optimal solution.

Ch. 1 (Section 1 – 5 and 11 – 18 of text 1)

Module 2

Linear Programming Contd. **(20 hrs)**

Simplex method (numerical example) Simplex tableau, Finding the first b.f. s., artificial variables, Degeneracy, simplex multipliers, Duality in LPP, Duality theorems, Application of duality, Dual simplex method.

Ch. 3 (Section 1 – 20 except 16 of text 1)

Module 3

Transportation and Assignment Problems (17 hrs)

Introduction, transportation problem, Transportation array, Transportation matrix, triangular basis, finding a basic feasible solution, testing of optimality, loop in a transportation problem, change the basis, Degeneracy, Unbalanced problem, Assignment problem.

Ch. 4 (Section 1 – 11 & 14 of text 1)

Module 4

Queuing Theory (15 hrs)

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

Ch. 16 (Section 16.1 – 16.4 of text 2)

Reference:

1. Operation Research by Kanti Swarup, P. K. Gupta and Man Mohan - (Sultan Chand and Sons)
2. Problems in Operations Research by Gupta P. K. and Hira D. S. - (S. Chand)
3. Operations Research by Ravindran A., Philip D. T. and Solberg J. J. - (John Wiley and Sons)
4. B. K. Mishra , B. Sharma – Optimization Linear Programming (Ane Books)
5. Mokhtar S. Bazaraa, J. J. Jarvis, H.D. Sherali – Linear Programming and Network Flows (Wiley India)

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	--
II	2	2	1	2
III	2	2	2	1
IV	3	3	2	1
Total	**10**	**10**	**7**	**4**

COMPLEMENTARY COURSES:

Mathematics for B.Sc Physics / Chemistry

Complementary Course -1

Course Code	15U1CPMAT1
Title of the course	Differential Calculus and Trigonometry
Semester in which the course is to be taught	I
No. of credits	3
No. of contact hours per week	4
Total Hours	72

COURSE AIM/RATIONALE.

Text Books: -

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

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Module 1

Differential Calculus:

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

(22 hrs)

(Sections 2.1 – 2.4, 3.1 – 3.6 of Text 1)

Module II

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 III

Partial Derivatives: **(15 hrs)**

Functions of several variables (Definition only), Partial derivatives, The Chain Rule
(Sections 14.3 - 14.4 of Text 1)

Module 1V

Trigonometry **(20hrs)**

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

(Relevant Sections in Chapter 3 – 5 and Chapter 8of Text 2)

Reference Books :

1. Shanti Narayan : Differential Calculus (S Chand)
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.
3. S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
4. Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D

I	3	2	1	1
II	2	3	2	1
III	2	2	2	1
IV	3	3	2	1
Total	**10**	**10**	**10**	**10**

Complementary Course - 2

Course Code	15U2CPMAT2
Title of the course	Integral Calculus and Matrices
Semester in which the course is to be taught	II
No. of credits	3
No. of contact hours per week	4
Total Hours	72

COURSE AIM/RATIONALE.

Text Books: -

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

2. Frank Ayres Jr : Matrices, Schaum's Outline Series, TMH Edition.

Module I

Integral Calculus: (15 hrs)

A quick review of indefinite integral as anti derivative. The Definite integral. The fundamental theorem of Calculus

(Section 5.3 and 5.4 of Text -1).

Module II

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 III

Multiple Integrals **(17 hrs)**

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

(As in Sections 15.1, 15.2, 15.3, 15.4 of Text - 1)

Module IV

Matrices **(20hrs)**

Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Equivalent matrices, Row Canonical form, Normal form, Elementary `matrices only.

Systems of Linear equations: System of non homogeneous, solution using matrices, Cramer's rule, system of homogeneous equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only) and simple applications

(Text 2, Chapters – 5, 10, 19, 23).

Reference Books :

1. Shanti Narayan , P .K . Mittal :Integral Calculus (S. Chand & Company)
2. Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand.

3. David W. Lewis - Matrix Theory (Allied)

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	2	3	1	-
III	2	3	2	2
IV	4	2	2	1
Total	**10**	**10**	**7**	**4**

Complementary Course - 3

Course Code	15U3CPMAT3
Title of the course	Vector Cauculus , Differentail Equations and Analytic Geometry
Semester in which the course is to be taught	III
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

Text :-

1. A. H Siddiqi , P Manchanada : A first Course in Differential Equations with Applications (Macmillan India Ltd 2006)

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

Module I

Vector valued Functions **(15 hrs)**

Vector Functions, Arc length and unit Tangent vector **T**, Curvature and unit Normal Vector **N**, Torsion and unit Binormal vector **B,** Directional Derivatives and Gradient Vectors**.**
(Sections 13.1, 13.3, 13.4, 13.5 and 14.5 of text 2)

Module II

Integration in Vector Fields **(25 hrs)**

Line Integrals, Vector fields and Work, Circulation and Flux, Path independence, Potential Function and Conservation Fields, Green's theorem in Plane (Statement and problems only), Surface area and Surface integral, Parameterised Surface, Stoke's theorem(Statement and Problems only), the Divergence theorem and a Unified theory (Statement and simple problems only).
(Sections 16.1 to 16.8 of text 2)

Module III

Ordinary differential equations **(25 Hrs)**

Exact Differential Equation, Linear Equations , Solutions by Substitutions, Equations of first order and not of first degree , First order equations of higher Degree solvable for p , Equations solvable for y , Equations solvable for x, Equations of first degree in x and y - Lagrange's and Clairaut's Equation
(sections 2.1 , 2.2 , 2.3 , 2.4 , 3.1 , 3.2 , 3.3 , 3.4 , 3.5 of text 1)

Module IV

Analytic Geometry **(25 hrs)**

Conic sections and Quadratic equations, Classifying Conic Sections by Eccentricity, Conics and Parametric equations, The Cycloid, polar co-ordinates, Conic Sections in Polar coordinates.
(Sections 10.1, 10.2, 10.4, 10.5, 10.8 of Text 2)

(exclude the pedal Method and Newtorian Method)

Reference Books :

1. Shanti Narayan , P .K . Mittal :Vector Calculus (S. Chand & Company)

2. P.P.G Dyke : An introduction to Laplace Transfoorms and Fourier Serices (Springer 2005)

3. Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.

4. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.

5. Merle C. Potter – Advanced Engineering Mathematics , Oxford University Press.

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	2	2	2	-
II	3	3	2	2
III	3	2	2	1
IV	2	3	1	1
Total	**10**	**10**	**7**	**4**

Complementary Course - 4

Course Code	15U4CPMAT4
Title of the course	Fourier Series , Differential Equations , Numerical Analysis and Abstract Algebra
Semester in which the course is to be taught	IV
No. of credits	4
No. of contact hours per week	5
Total Hours	90

COURSE AIM/RATIONALE.

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)
3. S.S . Sastry : Introductory methods of Numerical Analysis ,4th edition (Prentice Hall)
4. John B Fraleigh - A first course in Abstract Algebra (7th Edition) Pearson Education

Module I

Special Functions **(25 hrs)**

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

Legendre Polynomials – A brief introduction to power series and power series method solving Differential equations. Legendre equation and Legendre Polynomials , Rodrigues' Formula, Bessel's Equation .Bessel's Functions

(Sections 10.1, 10.2, 10.3, 10.4, 4.1, 4.3 , 4.5 of Text 1 – Excluding Proofs).

Module II

Partial Differential Equations **(15 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)

Module III

Numerical Analysis **(25 Hrs)**

(Use of Non Programmable Scientific Calculator is Permitted)

Absolute , relative and percentage errors. A general error formula . Error in a series Approximation. Bisection Method , Methods of false position , Iteration Method , Acceleration of convergence: Aitken's Δ^2 Process, Newton Raphson Method, the quotient – Difference method .

(section 1.3, 1.4, 1.5 , 2.1 , 2.2 , 2.3 , 2.4, 2.5 and 2.11 of Text 3)

Module IV

Abstract algebra **(25 hrs)**

Groups, Subgroups, Cyclic groups, Groups of Permutations and Homomorphisms, Rings and Fields , Vector Spaces.
(Section 1.4, 1.5, 1.6, 2.8, 3.13, 4.18, 6.30 of text 4)

Reference :

1. Stephen Andrilli, David Hecker - Elementary Linear Algebra ,Academic Press
2. Surjeet Singh, Qazi Zameeruddin - Modern Algebra Eighth Esition Vikas Pub. House
3. R. K. Ghosh, K. C. Maity – An Introduction to Differential Equations, New Central Books
4. Shepley L. Ross – Differential Equation , Wiley India
5. Srimanta Pal – Numerical Methods, Oxford University Press
6. Qazi Shoeb Ahamad, Zubir Khan – Numerical and Statistical Techniques, Ane Books

QUESTON PAPER PATTERN

Module	Part A	Part B	Part C	Part D
I	3	3	2	1
II	3	2	2	1
III	2	3	2	1
IV	2	2	1	1
Total	**10**	**10**	**7**	**4**

Syllabi

OPEN COURSE:

Open Course - 1

Course Code	15U5OCMAT1
Title of the course	Applicable Mathematics
Semester in which the course is to be taught	V

No. of credits	3
No. of contact hours per week	4
Total Hours	72

4 hours/week **4 credits**

The objective of module – 1 & 2 is to prepare students of all streams, particularly those with arts and commerce back ground for their higher studies. A detailed study is not necessary from these modules. All questions asked to be of arts students' standard

Module – 1 **(18 hours)**

Types of numbers, Quadratic equations (Solution of quadratic equations with real roots only), Logarithms – All rules with out 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 sinx, cosx, tanx, 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 hours)**

Probability – Introduction – Sample spaces and events, Simple examples like tossing coin , tossing die etc.., Differential Calculus - Differentiation – Standard results (derivatives) with out proof, Product rule, Quotient rule and function of function rule), Integral calculus (Integration simple cases, with and with out limits)
No core text book is needed for Modules 1 & 2

The objective of module – 3 & 4 is to prepare 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. Assignments not less than 20 questions may be given from each topic of these modules. (For University examinations it is to be specified, whether a problem is solved in detail or use some short cut method.)

Module – 3 **(18 hours)**

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 hours)**

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)

Core Reference – M. Tyra, & K. Kundan- CONCEPTS OF ARITHMETIC,
BSC PUBLISHING COMPANY PVT.LTD.
C – 37, GANESH NAGAR, PANDAV NAGAR COMPLEX
DELHI - 110092

QUESTION PAPER PTTERN

Module	Part A	Part B	Part C	Part D
I	3	2	2	1
II	2	3	1	1
III	3	2	2	1
IV	2	3	2	1
Total	**10**	**10**	**7**	**4**

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