ST.TERESA'S COLLEGE

DEPARTMENT OF MATHEMATICS

BOARD OF STUDIES IN MATHEMATICS

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1. Dr. A. Sunny Kuriakose, Professor and Dean, Department of Mathematics, FISAT, Ankamaly. (Chairperson).
2. Dr. Paul Isaac, Associate Professor, Department of Mathematics, Bharata Mata College, Thrikkakara.
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6. Nishi B.P, Sub Divisional Engineer(NS), Office of Principal General Manager Telecom, BSNL Bhavan, Ernakulam .(Expert from industry)

CERTIFICATE

The [illegible] syllabus of the Department of Mathematics for the year 2015-16 admission onwards, has been ratified by the Board of Studies of Mathematics which met on 31 st January,2015,at St Teresa's college , Ernakulam.

Members present

	Name, Designation and Address	Signature
1.	Dr. A. Sunny Kuriakose (Chairman) Professor and Dean, Dept. of Mathematics FISAT, Angamaly	31/1/15
2.	Dr. Paul Isaac Associate Professor, Dept. of Mathematics Bharata Mata College, Thrikkakara	31/1/2015
3.	Dr. T.P. Johnson Associate Professor, School of Engineering, CUSAT	31/1/2015
4.	Dr. Varghese Jacob Associate Professor, Dept. of Mathematics Govt. College, Kattayam.	31/1/15
5.	Nisha. B. P (Expert from Industry) Sub Divisional Engineer BSNL Bhavan, Ernakulam.	31/1/15

Faculty of the Department who have contributed to the restructuring of the syllabus:

Sl. No.	Name of the teachers	Designation	Area of Specialization
1	Teresa Felitia P.A	Associate Professor (HOD)	Complex Analysis, Differential Equations
2	Susan Mathew Panakkal	Assistant Professor	Algebra
3	Ursala Paul	Assistant Professor	Fuzzy Mathematics
4	Elizabeth Reshma M.T	Assistant Professor	Analysis
5	Neenu Susan Paul	Assistant Professor	Algebra
6	Lejo J. Manavalan	Guest Lecturer	Operations Research

ACKNOWLEDGEMENTS

The guidance of Dr. Beena Job Associate Professor, Department of English and IQAC Co-ordinator and Dr. Latha Nair, Associate Professor, Department of English and member of the Governing Council helped give shape to the overall structure. I wish to express my sincere thanks to Dr. N. J. Rao,Visiting Professor, International Institute of Information Technology, Bangalore and Dr. Rajan Gurukal, Former Vice-Chancellor, M.G. University, currently Visiting Professor, Centre for Contemporary Studies, Indian Institute of Science, for their selfless and timely service and for giving us all the help and guidance we needed . I also acknowledge my thanks to Dr. Achuthshankar S. Nair, Professor & Head, Department of Computational Biology and Bio Informatics, University of Kerala, for his invaluable suggestions.

Head of the Department

Smt. Teresa Felitia P.A

Foreword

The Higher Education environment is changing rapidly in India and particularly so in the year 2014-15, when the Government of Kerala decided to give autonomy to13 educational institutions in the state with the aim of improving quality. Quality in Higher education has been a matter of high concern and priority in India especially after the National Policy on Education 1986 has very categorically questioned the impact of education and suggested many measures for bringing innovative practices in education.

The autonomous status asks for more responsibility and increased accountability to frame a curriculum keeping in mind the ever changing academic environment and the plethora of demands placed by the diversity of students who have a high literacy level when it comes to choosing their course.

Keeping in mind that the purpose of Higher Education is the development of the people, society and environment, special care has been taken by the IQAC team at St. Teresa's College to give the necessary Orientation and to conduct Workshops related to curricula and scientific syllabus design as part of the Faculty Development Programme. Curriculum relates to the total experience of the student and it should contain knowledge that is essentially valid. The Graduate and Post Graduate Departments have worked diligently to frame curricula and develop programmes that foster analytical ability and critical thinking and enable the students to acquire the skills required by employers. The pedagogy adopted within the context of curriculum is to facilitate valid transmission of knowledge and proper evaluation of the same. The Courses designed at the Graduate and Post Graduate Levels have defined the competencies to enable effective teaching/learning of all the modules of the courses, both Core (compulsory) and Designate (elective). The blueprint of the final assessment of every course guarantees that all modules are taught and furthers integrity. The details of the course curriculum and structure are set in accordance with the course specifications of the affiliating university.

With sincere gratitude I acknowledge the efforts of Dr. N. J. Rao and Dr. Rajan Gurukkal who extended to us their academic expertise, astute guidance and unstinting support. I also thank Dr. Achuthshankar S. Nair for his timely guidance. *I specially thank all the faculty members and the IQAC coordinator Dr. Beena Job for their diligence, commitment and exceptional contribution towards this endeavour.*

Dr. Sr. Celine E

Contents

ST. TERESA'S COLLEGE, ERNAKULAM (AUTONOMOUS)
DEPARTMENT OF MATHEMATICS

BACHELOR'S PROGRAMME IN MATHEMATICS
Under Choice Based Course and Credit System

(Effective from 2015 admission onwards)

PREAMBLE

The courses for the Bachelor's Programme in Mathematics are framed by the Board of Studies using time tested and internationally popular text books so that the courses are at par with the courses offered by any other reputed university around the world.

Only those concepts that can be introduced at the under graduate level are selected and instead of cramming the course with too many ideas, the stress is given in doing the selected concepts rigorously. The course is framed in such a way that a graduate in Mathematics will have developed the required analytical skills and logical reasoning required to identify problems, construct proofs and find solutions.

GRADUATE ATTRIBUTES

The Department of Mathematics is committed to provide a culturally enriched educational experience that will transform the lives of its students. Our aspiration is for graduates who have developed the knowledge, skills and attributes to equip them for life in a complex and rapidly changing world.

On completion of the B.Sc Programme in Mathematics, our students should be able to demonstrate the graduate attributes listed below

- *Professionalism, employability and enterprise*
    - Proficiency in problem solving, creativity, numeracy and self-management.
    - Confidence in accepting professional challenges, act with integrity, set themselves high standards.
    - Ability to work independently and along a team with professional integrity.
- *Learning and research skills*
    - Acquire skills of logical and analytical reasoning.
    - Develop a critical attitude towards knowledge.
    - Equipped to seek knowledge and to continue learning throughout their lives.
    - Develop intellectual curiosity, effective learning and research abilities.
- *Intellectual depth, breadth and adaptability*
    - Proficiency in curricular, co-curricular and extracurricular activities that deepen and broaden knowledge
    - Develop skills of analysis, application, synthesis, evaluation and criticality.
- *Respect for others*
    - Develop self-awareness, empathy, cultural awareness and mutual respect.
    - Ability to work in a wide range of cultural settings and inculcate respect for themselves and others and will be courteous.
- *Social responsibility*
    - Knowledge in ethical behaviour, sustainability and personal contribution.
    - Awareness in the environmental , social and cultural value system.

OBJECTIVES:

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

By the end of the second semester, the students should have

1) Attained a secure foundation in Mathematics and other relevant subjects to complement the core for their future courses.

By the end of the fourth semester, the students should have been

1) Introduced to powerful tools for tackling a wide range of topics in Calculus, Theory of Equations and Numerical methods.
2) Familiarized with additional relevant mathematical techniques and other relevant subjects to complement the core.

By the end of sixth semester, the students should have

1) Understood a range of topics in almost all areas of Mathematics including Analysis, Graph Theory, Calculus, Fuzzy Mathematics, Operations Research and Algebra.
2) Experienced independent works such as project, seminar etc.

STRUCTURE OF BACHELOR'S PROGRAMME IN MATHEMATICS:

The Programme in Mathematics must include (1) Common courses, (2) Core courses, (3) Choice Based Courses (4) Open Courses (5) Project (6) Complementary Courses.

During the First four Semesters the student must complete 10 common courses of which Six English courses are compulsory and common for all streams. The students can choose one language course from among French, Hindi and Malayalam. There will be 13 core courses. The student shall select any choice based course from the two courses offered by the Department. Open course may be offered in any subject and the student shall have the option to do courses offered by other departments in the fifth semester. Every student has to do a project during the 6^{th} semester. The topics for the project can be selected as early as the beginning of the 5^{th} semester. Physics and Statistics are the Complementary Courses during the first four semesters.

COURSES:

Programme consists of 33 courses. The number of courses for the programme contains 12 compulsory core courses, one choice based course, one open course offered by other departments, one project and 8 complementary courses. There are 10 common courses which includes the first and second language of study.

Total credits will be 120 of which 38 credits for common courses, 46 for core courses,1 credit for the project,3 for choice based courses, 28 for Complementary Courses and 4 credits for open courses.

Open Courses and Choice Based Courses

The Department offers four open courses to the students of other streams. One course will be selected by the Department and offered to the students of other streams. The list of open courses is given below.

a) Applicable Mathematics

b) Mathematical Modelling

c) Financial Mathematics

d) Mathematical Economics.

The Department offers two choice based courses during the sixth semester. The students can choose one course according to their choice. The list of choice based course is given below:

a) Operations Research
b) Integral Transforms

SCHEME OF COURSES

The following table shows the structure of the programme which indicates title of the courses, instructional hours and credits.

Courses	Number of courses	Credits
Common Courses	10	38
Core courses	12	46
Project	1	1
Choice based course	1	3
Complementary Course I (Statistics)	4	14
Complementary Course II (Physics)	4 Theory + 2 Practical	14
Open Course	1	4
Total	33	120 (50 Core, 28 Complementary,4 Open Course, 38 Common Course)

Detailed distribution of courses for Bachelor's Programme in Mathematics

Sl: No	Semester	Courses	No: of Hours/week	No: of credits	Hours/semester	Exam duration	Total Marks	
							Sessionals	Finals
1	I	English I	5	4	90	3hrs	20	80
		English /Common course I	4	3	72	3hrs	20	80
		Second Language I	4	4	72	3hrs	20	80
		Mathematics Core Course – 1	4	3	72	3hrs	20	80
		Comp1 Course – I(Physics-theory)	2	2	36	3hrs	10	60
		Physics Practical	2	---	36	---	---	---
		Comp 2 Course – I(Statistics)	4	3	72	3hrs	20	80
2	II	English II	5	4	90	3hrs	20	80
		English /Common course II	4	3	72	3hrs	20	80
		Second Language II	4	4	72	3hrs	20	80
		Mathematics Core Course - 2	4	3	72	3hrs	20	80
		Comp1- Course – II(Physics-theory)	2	2	36	3hrs	10	60
		Physics Practical	2	2	36	3hrs	20	40
		Comp2 Course – II(Statistics)	4	3	72	3hrs	20	80
3	III	English III	5	4	90	3hrs	20	80
		Sec. Lang./Common course I	5	4	90	3hrs	20	80
		Mathematics Core Course - 3	5	4	90	3hrs	20	80
		Comp1 Course – III(Physics-theory)	3	3	54	3hrs	10	60
		Physics Practical	2	--	36	---	---	---
		Compl2 Course – III (Statistics)						

			5	4	90	3hrs	20	80
4	IV	English IV	5	4	90	3hrs	20	80
		Sec. Lang./Common course II	5	4	90	3hrs	20	80
		Mathematics Core Course - 4	5	4	90	3hrs	20	80
		Comp1Course – IV (Physics-theory)	3	3	54	3hrs	10	60
		Physics Practical	2	2	36	3hrs	20	40
		Comp2 Course – IV (Statistics)	5	4	90	3hrs	20	80
5	V	Mathematics Core Course - 5	5	4	90	3hrs	20	80
		Mathematics Core Course - 6	6	4	108	3hrs	20	80
		Mathematics Core Course - 7	5	4	90	3hrs	20	80
		Mathematics Core Course - 8	5	4	90	3hrs	20	80
		Open course	4	4	72	3hrs	20	80
6	VI	Mathematics Core Course - 9	5	4	90	3hrs	20	80
		Mathematics Core Course - 10	5	4	90	3hrs	20	80
		Mathematics Core Course - 11	5	4	90	3hrs	20	80
		Mathematics Core Course – 12	5	4	90	3hrs	20	80
		Mathematics Choice Based Course -13	4	3	72	3hrs	20	80
		Project	1	1	18		20	80

Course Code Format

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

a. The first two letters of the code indicate the name of the discipline i.e. PH (Physics), EN (English), History – HS, Hindi – HN, Malayalam – ML, **Maths – MT**, Computer Applications – CA, Communicative English – CE, Commerce – CO, Physics – PH, Physical Education - PE
b. One digit to indicate the semester. E.g., MT1 (Maths, 1st semester)
c. One letter to indicate the type of course, such as Common Course (which includes

English and Languages*) – A, Core Courses (Including Choice Based Electives) – B, Complementary Courses – C, Open courses – D.
E.g. MT1B (Maths, 1st semester, Core Course), MT2C (Maths, 2nd Semester, Complementary Course, MT5DMaths, 5th Semester, Open course).

d. One letter to indicate the streams for which a particular paper is taught. P for physics. C for chemistry, E for Economics, Eg.MT1CPC (Maths ,1st Semester, Complementary course common for Physics Chemistry, PC),MT1CE (Maths ,1st semester, complementary course for Economics)
e. Two digits to indicate the number of the course. All the courses are to be numbered continuously i.e., Core courses 01, 02, 03, etc., Common courses, 01, 02, etc., across the six Semesters. E.g. MT3B04 (Maths, 3rd Semester, Core Course, No 04), MT6B10 (Maths, 6th Semester, Core Course No 10).
f. One letter to indicate the Programme, i.e. Bachelor's – B
E.g. MT6B10B (Maths, 6th Semester, Core Course No 10, Bachelor's Programme), MT4CPC04B (Maths, 4th Semester, Complimentary Course common for physics and chemistry No 04, Bachelor's Programme).
g. Since we offer two Choice based courses we use small letter 'a' and 'b' to differentiate between them. Eg MT6B13aB(Maths, 6th Semester, core course 13 1st choice, Bachelor's Programme) MT6B13bB (Maths, 6th Semester, core course 13 2nd choice, Bachelor's Programme).
h. We offer four Open course we use small letters 'a', 'b', 'c' and 'd' to differentiate between them. Eg. MT5D01aB,(Maths,5th Semester, Open Course No.01,1st course-'a', Bachelor,s Programme). MT5D01cB,(Maths,5th Semester, Open Course No.01,third course-'c', Bachelor's Programme).

SCHEME OF CORE COURSES- MATHEMATICS

Semester		Title of the Course	Number of hours per week	Total Credits	Total hours/ semester
1	MT1B01B	Discrete Mathematics and Trigonometry	4	3	72
2	MT2B02B	Number Theory , Cryptography & Conic Sections	4	3	72
3	MT3B03B	Calculus	5	4	90
4	MT4B04B	Vector Calculus, Theory of Equations and Numerical Methods	5	4	90
5	MT5B05B	Real Analysis-I	5	4	90
	MT5B06B	Differential Equations	6	4	108
	MT5B07B	Abstract Algebra	5	4	90
	MT5B08B	Graph Theory	5	4	90
		Open Course	4	4	72
6	MT6B09B	Real Analysis -II	5	4	90
	MT6B10B	Complex Analysis	5	4	90
	MT6B11B	Fuzzy Mathematics	5	4	90
	MT6B12B	Linear Algebra	5	4	90
		Choice Based Course	4	3	72
		Project	1	1	18

SCHEME OF CHOICE BASED COURSES IN THE SIXTH SEMESTER:

Two choice based courses are offered by the Department. The students should select one among the two courses according to their choice in their sixth semester.

Semester	Course Code	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester
6th	MT6B13aB	Operations Research	4	3	72
6th	MT6B13bB	Integral Transforms	4	3	72

SCHEME OF OPEN COURSE FOR STUDENTS OF OTHER DEPARTMENTS DURING THE FIFTH SEMESTER

Semester	Course Code	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester
5th	MT5D01aB	Applicable Mathematics	4	4	72
5th	MT5D01bB	Mathematical Modelling	4	4	72
5th	MT5D01cB	Financial Mathematics	4	4	72
5th	MT5D01dB	Mathematical Economics	4	4	72

SCHEME OF COMPLEMENTARY COURSES

1. Mathematics for B.Sc Physics and Chemistry

Semester	Course Code	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	End Semester Assessment duration (hrs)
1	MT1CPC01B	Calculus	4	3	72	3
2	MT2CPC02B	Partial Derivatives, Multiple integrals Trigonometry and Matrices	4	3	72	3
3	MT3CPC03B	Vector Calculus , Differential Equations and Analytic Geometry	5	4	90	3
4	MT4CPC04B	Fourier Series , Differential Equations, Numerical Analysis and Abstract Algebra	5	4	90	3

2. Mathematics for B.A Economics

Semesters	Course Code	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	End Semester Assessment duration (hrs)
1	MT1CE01B	Graphing Functions, Equations And Fundamental Calculus	6	4	108	3
2	MT2CE02B	Exponential, Logarithmic Functions, Linear Algebra And Advanced Calculus	6	4	108	3

EXAMINATIONS :

The evaluation of each course shall contain two parts such as Sessional Assessment and Final Assessment. The ratio between Sessionals and Finals shall be 1:4 (20% : 80%)

Assessment Pattern:

Item	**Percentage**
Sessionals	**20**
Finals	**80**

Sessional Assessment:

Sessional Assessment is to be done by continuous assessments on the following components. The Components of the internal evaluation for theory papers are as below.

Theory :

Component	Marks
Attendance	5
Assignment/Seminar	5
Average of two test papers	10

Attendance

Minimum of 75% attendance is compulsory for a student to appear for the finals.

% of Attendance	Marks
>90%	5
Between 85 and 90	4
Between 80 and 85	3
Between 75 and 80	2
75 %	1
< 75	0

Assignments:

There will be one assignment per course in each of the first four Semesters. An Assignment/seminar/Viva will be conducted for each course in the Fifth Semester. Each student should present a seminar in the 6^{th} Semester.

Sessional Assessment:

The evaluation of all components is to be published and is to be acknowledged by the candidate. The responsibility of evaluating the Sessionals is vested on the teacher(s) who teach the course.

Final Assessment:

The Final examination for all semesters shall be conducted by the College on the close of each semester. There will be no supplementary exams. For reappearance/ improvement, students can appear along with the next batch.

Pattern of Question Paper :

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

For each course the *Final assessment* is of 3 hours duration. The question paper has 4 parts. Part A is compulsory which contains 6 objective type questions each of 1 mark. Part B contains 10 short answer questions of which 7 are to be answered and each has 2 marks. Part C has 8 short essay questions of which 5 are to be answered and each has 6 marks. . Part D has 4 long essay questions of which 2 are to be answered and each has 15 marks.

Part	**No. of Questions**	**No. of questions to be answered**	**Marks**
A (Objective type)	6	6	6x1 = 6
B (Short Answer)	10	7	7x2 = 14
C (Short Essay)	8	5	5x6 =30
D (Long Essay)	4	2	2x15 = 30

Projects :

All students must do a project. The project can be done individually or as a group of maximum 4 - 5 students. However, the viva on this project will be conducted individually. The projects are to be identified during the VIth semester of the programme with the help of the supervising teacher. The report of the project is to be submitted to the department and is to be produced before the examiners appointed for valuation.

1. Sessional Evaluation: 10 marks

Component	Marks
Punctuality	2
Content and Compilation	4
Group involvement	2
Presentation	2

2. External Evaluation of Dissertation: 30 marks

Component	Marks
Innovation of topic	5
Objective	5
Literature Review	5
Content	5
Result / Applications	5
Presentation	5

3. Viva –Voce on Project: 10 marks

Final Grade System:

For all courses, grades are given on a 07-point scale based on the total percentage of marks. (Sessionals + Finals) 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	4

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

Computation of Credit point and credit point average:

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

CP = C × GP, where C = Credit for the course; GP = Grade point

Semester Credit Point Average (SCPA) is calculated as

SCPA= $\frac{TotalCreditPoints\ (TCP)}{TotalCredits\ (TC)}$, where TCP = Total Credit Point; TC = Total Credit

CPA	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

Cumulative Credit Point Average for the programme is calculated as follows:

$$\textbf{CCPA} = \frac{(TCP)_1 + (TCP)_2 \ldots\ldots\ldots + (TCP)_6}{TC_1 + TC_2 + \ldots + TC_6}$$

where **TCP_1……..., TCP_6** are the **Total Credit Points** in each semester and **TC_1……..., TC_6** are the **Total Credits** in each semester

Note: A separate minimum of **30% marks** each for Sessionals and Finals (for both theory and practical) and an aggregate minimum of **40 % is** required for the pass of a course. For 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. A candidate who secures **E** grade and above will be eligible for higher studies.

Syllabi of Courses:

The detailed syllabi of the courses for core and complimentary is appended.

For the Board of Studies in Mathematics,

Dr. A Sunny Kuriakose
(Chairperson)

SYLLABI OF CORE COURSES

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 1)
FIRST SEMESTER

Name of the Course: MT1B01B-DISCRETE MATHEMATICS & TRIGONOMETRY

Duration: One Semester

Total Credits : 3 Credits

Total Lecture Hours: 72 (4 hours /week)

Aims:

The course aims to introduce Discrete Mathematics & Advanced Trigonometry . One of the strong points of Discrete Mathematics is its powerful applications to fields like Computer Science, engineering and operations research. This course also discusses some advanced topics in trigonometry which has a wide range of applications in the Engineering and construction field.

Course Overview and Context :

This course starts by introducing the alphabets of modern mathematics the mathematical logic and the sets and functions. A brief introduction of theory of Ordered sets & Lattices is also included. The concepts of Circular and hyperbolic functions of a complex variable are then introduced.

Syllabus Content

Module 1 **(15 hrs)**

Mathematical Logic: Logical statement or proposition, Types of propositions, The Propositional Calculus, The negation of proposition, Disjunction, Conjunction, Tautologies & Contradictions,Logical Equivalence, The Algebra of propositions, Conditional propositions, Converse,Inverse & Contrapositive propositions, The negation of a Conditional propositions, Biconditional propositions, Arguments

(Text - 1 Chapter - 1)

Module 2 **(17 hrs)**

Sets, Union, Intersection, Complementation, Symmetric Difference, Power set, Cartesian Products, Generalized set theory, Relation, equivalence relations, Partition, partial order Relation ,Functions, Inverse Mappings, Composition of Mappings

(Text - 1 Chapter 2 & Chapter 3 excluding Section 3.8 & 3.9)

Module 3 **(20 hrs)**

Ordered sets & Lattices : Poset, Product set & order, Hasse diagrams of partially ordered sets,Minimal & Maximal, and First & Last point, Lattices, Lattices as partially ordered sets.

(Text book 1, Chapter – 4 (4.1 to 4.6)).

Module 4

Trigonometry : **(20 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 of Text 2)

Learning Resources

Textbook

1. B.S.Vatsa & Suchi Vatsa : Discrete Mathematics (Fourth revised edition), New Age International Publishers, New Delhi
2. S.L. Loney – Plane Trigonometry Part – II, S. Chand and Company Ltd

References

1. J. P Tremblay and R. Manohar- Discrete Mathematical Structures with applications to computer science, Tata McGraw-Hill Education, 2001
2. Lipschutz: Set Theory and related topics (Second Edition), Schaum Outline Series, Tata McGraw-Hill Publishing Company, New Delhi. (Reprint)
3. P.R. Halmos : Naive Set Theory, Springer.

4. Ian Chiswell & Wifrid Hodges: Mathematical Logic, Oxford university press
5. Richard Johnsonbaugh – Discrete Mathematics (Pearsons)
6. K.H. Rosen: Discrete Mathematics and its Applications (Sixth edition), Tata McGraw Hill Publishing Company, New Delhi.

Competencies of the course:

- Explain the Propositional Calculus in Mathematical Logic.
- Describe Set theory , Relations & Functions
- Explain Ordered sets & Lattices
- Define Circular and hyperbolic functions of a complex variable
- Illustrate the Separation of these functions into real and imaginary parts
- Examine the Factorisation of x^n-1, x^n+1, $x^{2n} - 2x^n a^n \cos n\theta + a^{2n}$
- Define Summation of infinite series by C + iS method

BLUE PRINT

MT1B01TB-DISCRETE MATHEMATICS & TRIGONOMETRY

Module	Part A	Part B	Part C	Part D
I	2	2	1	1
II	2	2	3	1
III	1	3	2	-
IV	1	3	2	2
Total	**6**	**10**	**8**	**4**

MODEL QUESTION PAPER

FIRST SEMESTER
CORE COURSE-MT1B01B-DISCRETE MATHEMATICS & TRIGONOMETRY

Time: 3 hrs. Max.Marks:80

Part A
Short answer questions
(Answer all questions. Each question carries 1 mark)

1. Let A = {a, b, c, d} and B = $\emptyset$ then find A X B
2. What is the imaginary part of $\sinh(2+3i)$?
3. Determine whether the function f(x) = x^2 from the set of integers to the set of integers is one to one.
4. Let A = {1, 2, 3, 4}. Which ordered pairs are in the relation R = {(a, b)/ a divides b}
5. Express the statement using logical operators , predicts and quantifiers "The negation of a contradiction is a tautology"
6. Find the negation of the proposition "At least 10 inches of rain fell today in Miami ".

Part B
Brief answer Questions
(Answer any seven questions. Each question carries 2 marks)

7. Let A, B and C be sets. Show that $\overline{A \cup (B \cap C)} = (\overline{C} \cup \overline{B}) \cap \overline{A}$
8. What is the composite of the relations R and S, where R is the relation from {1, 2, 3} to {1, 2, 3,4} with R= {(1, 1), (1, 4), (2, 3), (3, 1), (3, 4)} and S is the relation from {1, 2, 3, 4} to {1, 2, 3, 4} with S= {(1, 0), (2, 0), (3, 1), (3, 2), (4, 1)}.
9. Show that the inclusion relation $\subseteq$ is a partial ordering on the power set of a set S.
10. Give an example for a relation which is not symmetric but transitive.
11. Show that $(p \wedge q) \rightarrow (p \vee q)$.
12. State the converse and contra positive of the conditional statement
    "I go to the beach whenever it is a sunny summer day"
13. If $\tan\frac{\theta}{2} = \tanh\frac{u}{2}$, Show that $\sinh u = \tan\theta$
14. If x is real show that $\sinh^{-1} x = \log(x + \sqrt{x^2+1})$

15. If $\cos(x+iy) = \cos\theta + i\sin\theta$. Show that $\cos 2x + \cosh 2y = 2$.

16. Is the poset (Z^+, |) a lattice?

Part C

Descriptive (Short essay questions)

(Answer any five questions. Each question carries 6 marks)

17. Prove that the relation R on a set A is transitive if and only if $R^n \subseteq R$ for n = 1, 2, 3….

18. Draw the Hasse diagram for the partial ordering $\{(A,B)|A \subseteq B\}$ on the power set P(S), where S={a,b,c}

19. (a) Define an equivalence relation

(b) Let R be the relation on the set of real numbers such that xRy if and only if x and y are real numbers that differ by less than 1, that is $|x - y| < 1$. Show that R is not an equivalence relation

20. (a) When does a function have an inverse?

(b) Does the function f(n) = 10 – n from the set of integers to the set of integers have an inverse?

If so what is it?

21. Let f be a function from A to B. Let S and T be subsets of B. Show that

(a) $f(SUT) = f(S)\ U\ f(T)$

(b) $f^{-1}(S \cap T) = f^{-1}(S) \cap f^{-1}(T)$.

22. Determine the truth value of the following statements if the domain consists of all real numbers

(a)

$\exists x\ (x^3 = -1)$ (b) $\exists x\ (x^4 < x^2)$ (c) $\forall x\ ((-x)^2 = x^2)$ (d) $\forall x\ (2x > x)$

23. Prove that $x^7 + 1 = (x+1)\sum_{r=0}^{2}(x^2 - 2x\cos\frac{(2r+1)\pi}{7} + 1)$. Deduce that $\sin\frac{\pi}{14}\sin\frac{3\pi}{14}\sin\frac{5\pi}{14} = \frac{1}{8}$.

24. Find the real and imaginary part of $\tan^{-1}(x+iy)$

Part D

Long essay type questions

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

25. Sum to infinity the series

$$\cos x \sin x + \frac{\cos^2 x}{2!}\sin 2x + \frac{\cos^3 x}{3!}\sin 3x + \ \ldots\ldots\ldots\ldots$$

26. (a) If a and r are real numbers and $r \neq 0$, then show that

$$\sum_{j=0}^{n} a.r^j = \begin{cases} \dfrac{a.r^{n+1} - a}{r - 1} & \text{if } r \neq 1 \\ a(n+1) & \text{if } r = 1 \end{cases}$$

(b) Show that the set of rational numbers is countable

(c) Find the sum

$$\sum_{k=50}^{100} k^2 \ \text{ and } \ \sum_{k=99}^{200} k^3$$

27. (a) Determine whether $(\neg p \wedge (p \rightarrow q)) \rightarrow \neg q$ is a tautology.

(b) Show that $p \leftrightarrow q$ and $(p \wedge q) \vee (\neg p \wedge \neg q)$ are logically equivalent

28. Find the sum of the infinite series

$$\cos\theta + \frac{1}{2}\cos 2\theta + \frac{1.3}{2.4}\cos 3\theta + \frac{1.3.5}{2.4.6}\cos 4\theta + \ \ldots\ldots\ldots$$

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 2)

SECOND SEMESTER

Name of the Course : **MT2B02B- NUMBER THEORY, CRYPTOGRAPHY & CONIC SECTIONS**

Duration: One Semester

Total Credits : 3 Credits

Total Lecture Hours: 72 (4 hours /week)

Aims: Classical number theory is introduced in this course. The theory of numbers always occupied a unique position in the world of Mathematics. Another topic in this course is cryptography which is the only known practical means for protecting information transmitted through public communication networks. Then it gives geometric definitions of conic sections which models the path of planets and satellites.

Course Overview and Context : This course aims to give a simple account of classical number theory and to impart some of the historical background in which the subject evolved. The topics discussed under cryptography are Private key cryptosystem, Private key cryptosystem and knapsack cryptosystem Also it describes conic sections and their properties. .

Syllabus Content

Module 1

Number Theory : **(20 hrs)**

Mathematical Induction, Binomial Theorem, Early number Theory**,** the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c, The fundamental theorem of arithmetic. The sieve of Eratosthenes.

Chapter 1, 2, 3 (Except 3.3) of Text 1

Module 2

Number Theory **(20 hrs)**

Carl Friedrich Gauss, Basic properties of congruence , Binary and decimal representation

of integers, Linear congruences and Chinese remainder theorem , Pierre de Fermat, Fermat's little theorem and pseudoprimes, Wilson's theorem, The sum and number of divisors, The greatest integer function , Leonard Euler, Euler's phi-function, Euler's Theorem, Properties of the phi-function.

Chapter 4,5,6,7 (Except 5.4, 6.2, 6.4) 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 1)

Module 4

Conic Sections: **(17 hrs)**

Conic Sections & quadratic equations, Classifying Conic Sections by eccentricity, quadratic equations & rotations, Conics & parametric equations;Cycloid, Polar coordinates, Graphing in Polar coordinates, Areas & lengths in Polar coordinates, Conic Sections in Polar coordinates (Text - 2 Chapter - 10)

Learning Resources

Textbook

1. David M. Burton : Elementary Number Theory, Sixth Edn, TMH.
2. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson,

References

1. Manicavachagom Pillay , Natarajan – Analytic Geometry (Part I, Two Dimensions)
2. S.K . Stein – Calculus and analytic Geometry , (McGraw Hill)
3. A. N. Das – Analytic Geometry of Two and Three Dimension (New Central Books)
4. Thomas and Finney - Calculus and analytical geometry (Addison-Wesley)
5. C.Y Hsiung Elementary Theory of Numbers, Allied Publishers
6. Thomas Koshy - Elementary Number Theory with Applications, Academic Press
7. Fernando Rodriguez Villegas: Experimental Number Theory, Oxford University Press
8. Graham Everest, Thomas Ward: An Introduction to Number Theory, , Springer

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

Competencies of the course:

- Describe Mathematical Induction and Binomial Theorem
- Introduce the division algorithm
- Compute the greatest common divisor
- Describe the Euclidean algorithm
- Explain the Diophantine equation ax + by = c
- Introduce The fundamental theorem of arithmetic & The sieve of Eratosthenes.
- Describe Basic properties of congruence
- Compute Binary and decimal representation of integers
- Introduce Chinese remainder theorem and Fermat's little theorem
- Describe pseudoprimes
- Explain Wilson's theorem
- Compute The sum and number of divisors, The greatest integer function
- Introduce Euler's phi-function, Euler's Theorem, Properties of the phi-function.
- Define Conic Sections and Classify Conic Sections by eccentricity
- Interpret parametric equations & Polar coordinates of Conic Sections
- Explain Graphing in Polar coordinates
- Introduce Private key cryptosystem
- Analyse Public key cryptosystem
- Describe knapsack cryptosystem.

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MT2B02B- NUMBER THEORY, CRYPTOGRAPHY & CONIC SECTIONS

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	1	3	3	1
III	1	2	1	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

Model Question Paper

SECOND SEMESTER
CORE COURSE-MT2B02B-NUMBER THEORY, CRYPTOGRAPHY & CONIC SECTIONS

Time: 3 hrs. Max.Marks:80

Part A
Short answer questions
(Answer all questions. Each question carries 1 mark)

1. Using Euclidean Algorithm find the gcd (58,86).
2. Find the number of divisors of 7128.
3. Find a number x such that $2x \equiv 1 \pmod 5$.
4. Give an example of a super increasing sequence
5. Give the focus of the parabola $y^2 = -4px$
6. What is the eccentricity of a circle?

Part B
Brief answer Questions
(Answer any seven questions. Each question carries 2 marks)

7. Prove that every number is of the form 5n, $5n \pm 1$, $5n \pm 2$.
8. Find the highest power of 5 contained 158!.
9. If n is any number, Prove that $n(n+1)(n+2)$is divisible by six
10. Prove that the square of every odd number is of the form 8n+1.
11. Solve $5x \equiv 2 \ (mod 7)$.
12. Show that $7^{2n} - 48n - 1$ is divisible by 2304
13. What is the difference between mono alphabetic cipher and poly alphabetic cipher?
14. Encipher the message *ALL THE BEST* using a Vignere cipher with keyword *VERY*.
15. Sketch the region in the XY - plane whose coordinates satisfy the inequality $4y2 - x2 \geq 4$
16. Find the directrix of the ellipse $2x^2 + y^2 = 2$

Part C
Descriptive (Short essay questions)

(Answer any five questions. Each question carries 6 marks)

17. Find the GCD (26,382) and express it as a linear combination of the two integers 26 and 382.
18. Prove that every composite number has at least one prime divisor.
19. If n is a positive integer , prove that

$$\frac{1}{n}+\frac{1}{n+1}+\frac{1}{n+2}+\ \ldots+\frac{1}{2n-1}=1-\frac{1}{2}+\frac{1}{3}-\frac{1}{4}+\cdots+\frac{1}{2n-1}$$

20. Show that $18!+1$ is divisible by 437.
21. Use the Hill cipher

$$C_1 \equiv P_1 + P_2 \pmod{26}$$

$$C_2 \equiv P_1 + P_2 \pmod{26}$$

to encipher the message *GIVE THEM TIME*

22. The parabola y2 = 8x is shifted down 2 units and right 1 unit. Find the equation of the new parabola, new vertex, new focus and new directrix.
23. Find the center, foci, vertices, asymptotes of 2x2 - y2 + 6y = 3
24. State and prove Wilson's Theorem

Part D
Long essay type questions

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

25. Derive the equation of the ellipse whose foci are at (±c, 0).
26. (a) If a and b are two numbers, prove that there exists a unique number g such that common divisor of a and b are the same as the divisors of g.

    (b) State and prove Euler's extension of Fermat's theorem.

    (c) Show that the nineth power of any number is one of the forms $19m, 19m+1$.
27. State and prove Chinese remainder theorem
28. Explain RSA cryptosystem.

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 3)
THIRD SEMESTER

Name of the Course: MT3B03B-CALCULUS
Duration: One Semester

Total Credits: 4 Credits

Total Lecture Hours: 90 (5 hours /week)

Aims:

Calculus is the mathematical study of change. The studies of probability, statistics , fluid dynamics electricity to mention a few lead in natural ways to functions of more than one variables. In studying quantities that depend on two or more variables we extend the basic idea of calculus to functions of several variables. We use multiple integrals to calculate quantities that vary over two or more dimensions such as total mass or angular momentum of an object of varying density and the volumes of solids with general curved boundaries..

Course Overview and Context:
This course introduces higher order derivatives, Leibnitz theorem, for higher derivatives of the product of two functions. Series expansions of functions using Maclaurin's theorem and Taylor's theorem are discussed. Some applications of derivatives in finding maxima, minima, point of inflection etc are introduced. The concept of partial derivatives and its properties are also introduced.

In integral calculus, certain reduction formulae are discussed. Application of integrals in finding plane area, surface area, arc length, and volume of solids of Revolution are introduced and double and triple integrals and some applications are also introduced.

Syllabus Content:

Module I

Differential Calculus **(30 hrs)**

Successive Differentiation. Expansion of functions using Maclaurin's theorem and Taylor's theorem. Concavity and points of inflexion.
(Text 2 Chapter - 5, Chapter – 6, Chapter 13)

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)

Learning Resources

Textbook

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.
2. Shanti Narayan and P. K. Mittal– Differential Calculus(S. Chand & Co.) 2008.

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.

Competencies of the course:

- Find the higher order derivative of the product of two functions.
- Expand a function using Taylor's and Maclaurin's series.
- Find points of extreme values attained by a function on a given interval.
- Conceive the concept of Convexity and Concavity of functions.
- 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 .

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MT3B03B-CALCULUS

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	1	3	2	1
III	1	2	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 4)
FOURTH SEMESTER

Name of the Course: MT4B04B- VECTOR CALCULUS, THEORY OF EQUATIONS AND NUMERICAL METHODS

Duration: One Semester
Credits: 4 credits
Total Lecture Hours: 90 (5 hours/week)
Aims:

We need a mathematical description of three dimensional spaces to apply calculus in many real world situations. Vectors are used to study the analytic geometry of space, where they give simple ideas to describe lines, planes surfaces and curves in space. Numerical methods are gainfully employed by scientists and engineers to solve problems arising in research and industry.

Course Overview and Context:

This course discusses equations of lines and planes in space, introduces elementary methods to find roots of an equation, gives an overview on relation between roots and the coefficients of an equation.

Syllabus Content:

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 hrs)**

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

(Sections 16.1 to 16.8 of Text 1)

Module III

Theory of Equations **(25 hrs)**

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

(Chapter 6 and Descartes Rule of signs also, 11 , 12 of Text 2)

Module IV

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

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

(Sections 2.2, 2.3, 2.4, & 2.5 of Text 3)

Learning Resources

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.

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).

Competencies of the course:

- Interpret equations of lines and planes in space
- Explain integration in vector fields.
- Verify Stoke's Theorem, Gauss Divergence Theorem and Green's Theorem.
- Analyse the fundamental theorem of algebra
- Solve equations of nth degree
- Find the equations whose nature of roots is given.
- Solve third degree equations using Cardan's method.
- Find roots of fourth degree equations using Ferrari method.
- Interpret the relation between roots and coefficients.
- Apply Descarte's rule of signs to find the number of real and imaginary roots of a given equation.
- Execute various numerical analysis methods to obtain roots of an equation.

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MT4B04B- VECTOR CALCULUS, THEORY OF EQUATIONS AND NUMERICAL METHODS

Module	Part A	Part B	Part C	Part D
I	2	4	2	0
II	2	3	2	2
III	1	2	2	1
IV	1	1	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 5)
FIFTH SEMESTER

Name of the Course: **MT5B05B- REAL ANALYSIS -I**

Duration : One Semester

Total Credits : 4 Credits

Total Lecture Hours : 90(5 hours /week)

Aims: Real analysis is a branch of mathematical analysis dealing with the real numbers and real-valued functions of a real variable. In particular, it deals with the analytic properties of real functions and sequences, including convergence and limits of sequences of real numbers, the calculus of the real numbers, and continuity, smoothness and related properties of real-valued functions.

Course Overview and Context: This course provides a systematic approach to the development of the subject Real Analysis. It introduces several fundamental concepts of Real Analysis including the well-ordering *principle,* the completeness axiom, the Archimedean property and the real sequences. Also to the end more abstract notions of a metric space are introduced.

Syllabus Content

Module I **(15 hrs)**

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

Module II **(25hrs)**

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

Module III **(30 hrs)**

Real sequences. The range, bounds of a sequence. Convergence of sequences. Some

theorems, limit points of a sequence. Bolzano weierstrass theorem for sequences. Limit interior and superior. Convergent sequences. Cauchy's general principle of convergence. Cauchy's sequences. Statements of theorem without proof in algebra of sequences. Some important theorems and examples related to them. Monotonic sequences, 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 hrs)**

Metric Spaces
Definitions & examples, Open & Closed Sets, Convergence & Completeness, Continuity & Uniform Continuity
(Section 1 to 4 of chapter 19 of text 1)

Learning Resources

Textbook

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

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

Competencies of the course:

- Explain Real number system and some of its basic properties
- Define the basic concepts needed for real analysis
- Explain Bolzano weierstrass theorem for sets.
- Describe Real sequences,its Convergence Some theorems
- Explain limit points of a sequence
- Interpret Bolzano weierstrass theorem for sequences.

- Examine Limit interior and superior.
- Interpret Cauchy's general principle of convergence & Cauchy's sequences.
- Define Monotonic sequences & subsequences
- Define Metric Spaces and some of its concepts

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MT5B05B- REAL ANALYSIS -I

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	1	3	2	1
III	1	2	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 6)
FIFTH SEMESTER

Name of the Course: MT5B06B-DIFFERENTIAL EQUATIONS
Duration: One Semester
Credits: 4 credits
Total Lecture Hours : 108(6 hours/week)
Aims:

Since the time of Isaac Newton differential equation have been of fundamental importance in the application of Mathematics to the Physical Science. Lately differential equations gained increasing importance in the Biological and Social Science. The integrals of ordinary differential equation are plane curves. Also we should study the differential equation involving one dependant and more than one independent variables that are partial differential equation. Such integrals are space curves and surfaces. Partial differential equation can arise in a variety of ways in Geometry, Physics, etc.

Course Overview and Context:

In this course we are studying the ordinary differential equation involving one independent and one or more dependent variables. The integrals of ordinary differential equation are plane curves. Also we study the differential equation involving one dependant and more than one independent variable that are partial differential equation.

Syllabus Content:

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 (30hrs)

Basic theory of linear differential equations, 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 2Section 1, 2 and 4 oftext 2)

Learning Resources

Textbook

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

References

1. A.H.Siddiqi & P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)
2. George. F. Simmons – Differential equation with applications and historical notes (Tata 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

Competencies of the course:

- Recognise exact differential equations.
- Obtain an integrating factor which may reduce a given differential equation into an exact one and eventually provide its solution.
- Obtain the solution of separable equations and equations reducible to this form.
- Identify linear equation, Bernoulli equations and solve them.
- Obtain orthogonal trajectories and Oblique trajectories of families of curve son a given surface.
- Find the complementary function and particular integrals of linear differential equation.
- Derive solution of homogeneous equations with constant coefficient.
- Understand method of variation of parameters.
- Solve Bessel's equations.
- Obtain power series expansion about an ordinary point.
- 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.

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MT5B06B-DIFFERENTIAL EQUATIONS

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	1	3	3	2
III	1	3	2	1
IV	2	2	1	0
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 7)

FIFTH SEMESTER

Name of the Course : MT5B07B -ABSTRACT ALGEBRA

Duration: One Semester

Credits: 4 credits

Total Lecture Hours :90 (5 hours/week)

Aims: Abstract Algebra is an important branch of Mathematics that has wide applications in almost all branches of Science. Algebra studies the structure of sets with operations on them.This course aims to provide the students with the basic topics of abstract algebra so as to understand its role in modern mathematics and its applications to other fields

Course Overview and Context:

A study of the basic concepts of groups, rings and fields is done. This course also discusses about homomorphism and isomorphism of groups. An introduction to ideals is also included

Syllabus Content

Module 1 **(20 hrs)**

Binary Operations; Isomorphic Binary Structures; Groups; Subgroups

(Sections 2, 3, 4 & 5)

Module 2 **(25 hrs)**

Cyclic Groups; Generating Sets (excluding Cayley Digraphs);

Groups of Permutations; Orbits, Cycles and the Alternating Groups

(Sections 6, 7-excluding Cayley Digraphs, 8 & 9)

Module 3 **(25 hrs)**

Cosets and the Theorem of Lagrange; Direct Products-(definition and examples only, all theorems without proof); Homomorphisms; Factor Groups; Factor Group Computations and Simple Groups

(Sections 10,11-(definition and examples only, excluding Finitely Generated Abelian Groups); 13, 14 15)

Module 4 **(20 hrs)**

Rings and Fields; Integral Domains.

(Sections 18, 19)

Learning Resources:

Textbook:

John B.Fraleigh - A first course in Abstract Algebra (7^{th} Edition), Pearson.

References :

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

Competencies of the Course:

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

- define groups, rings and fields .
- explain different properties of groups.
- identify examples of groups, rings and fields.
- explain homomorphism and isomorphism of groups.
- describe cosets and factor groups.
- differentiate between the different algebraic structures.
- solve problems related to groups and rings

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MT5B07B -ABSTRACT ALGEBRA

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	2	3	2	2
III	1	3	2	1
IV	1	2	2	0
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 8)
FIFTH SEMESTER

Name of the Course: MT5B08B- GRAPH THEORY

Duration: One Semester

Credits: 4 credits

Total Lecture Hours : 90 (5hours/week)

Aims: Graph theory is acknowledged as an important subject in the under graduate mathematics curriculum. Graph theory has a surprising number of applications, not just to computer science but to many other sciences (physical, biological and social), engineering and commerce.

Course Overview and Context:

This course introduces the basic concepts of graph theory. A detailed explanation of different types of graphs and their properties is included.

Syllabus Content

Module I : **(25 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)

Module 2 **(20 Hrs)**

Trees and connectivity. Definitions and Simple properties, Bridges, Spanning trees, Cut vertices and connectivity. Euler Tours and Hamiltonian Cycles .Euler's Tours, The Chinese postman problem .

(Section 2.1,2.2,2.3,2.6,3.1(algorithm deleted) 3.2(algorithm deleted)of text 1)

Module 3: **(20 Hrs)**

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 3.3, 3.4 (algorithm deleted), 4.1,4.2 4.3(algorithm deleted),4.4 (algorithm deleted) of text 1)

Module 4: **(25 Hrs)**

Directed graphs Definitions –In degree and out degree, Tournaments

(Section 7.1, 7.2, 7.3)

Learning Resources:

Text books:

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

Reference:

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,
5. S. A. Choudam –A First Course in Graph Theory (Macmillian)
6. P.P.G Dyke -An Introduction to Laplace Transforms and Fourier Series,Springer (India) Pvt Ltd
7. D.V.Widder-The Laplace Transform, Dover Publications Inc

Competencies of the course.

- describe the basic concepts of graph theory
- construct different types of graphs.
- Evaluate the adjacency matrix and incidence matrix of a graph.

- identify trees, paths and cycles in graphs.
- differentiate between Hamiltonian and eulerian graphs.
- identify cut vertices of a graph if any.
- identify the bridges of a graph if any.
- define the vertex connectivity of a graph .
- solve various real life problems graphically.
- construct directed graphs.
- evaluate in degree and out degree of vertices of a directed graphs.

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MT5B08B- GRAPH THEORY

Module	Part A	Part B	Part C	Part D
I	3	3	1	1
II	1	2	2	1
III	1	2	2	1
IV	1	3	3	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 9)
SIXTH SEMESTER

Name of the Course: MT6B09B- REAL ANALYSIS II

Duration: One Semester

Total Credits : 4 Credits

Total Lecture Hours: 90 (5 hours/week)

Aims : This course aims to define Infinite Series, its convergence and some tests to identify the nature of convergence, Continuous functions and some theorems on continuity. It also introduces Riemann Integration, Uniform Convergence of sequence of functions and some tests for it.

Course Overview and Context :

This course covers the fundamentals of mathematical analysis: convergence of sequences and series, continuity, differentiability, Riemann integral, sequences and series of functions, uniformity, and the interchange of limit operations. It shows the utility of abstract concepts and teaches an understanding and construction of proofs .

Syllabus Content

Module I :
Infinite Series (**20 hrs)**

A necessary condition for convergence. Cauchy`s general principle of convergence for a series. Positive term series. A necessary condition for convergence of positive term series. Geometric series. The comparison series $\sum\frac{1}{hP}$ comparison test for positive term series without proof. Cauchy`s root test D'ALEMBERTÈS RATIO test. Raabe's test. Gauss`s test. Series with arbitrary terms. Alternating series. Absolute convergence
(Section 1.1 to 1.4,2 ,2.1 to 2.3,3,4,5,6,9,10,10.1,10.2 of chapter 4 of Text 1)
Module II :

Continuous functions (**25 hrs)**

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

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

Module III :

Riemann Integration (**30 hrs)**

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

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

Module IV :

Uniform Convergence (**15 hrs)**

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)

Learning Resources

Textbook

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

References

2. 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

Competencies of the course:

- Define infinite series of real numbers and its convergence
- Explain some tests to identify nature of convergence of infinite series.
- Describe Continuous functions and some theorems on continuity

- Introduce Riemann Integration
- Explain The fundamental theorem of calculus.
- Describe Uniform Convergence of sequence of functions .
- Explain tests for uniform convergence of sequences and series

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MT6B09B- REAL ANALYSIS II

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	1	3	2	1
III	1	2	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

BSc DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 10)

SIXTH SEMESTER

Name of the Course: MT6B10B- COMPLEX ANALYSIS
Duration: One Semester
Credits: 4 credits
Total Lecture Hours: 90 (5 hours/week)

Aims: To explain the fundamental ideas of Analytic functions, introduce elementary complex functions, discuss basic methods of complex integration, discuss power series expansion of analytic functions.

Course Overview and Context:

This course introduces the concepts analytic function, elementary complex functions, and their properties, basic methods of complex integration and its applications in contour integration

Syllabus Content:

Module 1 **(30 hrs)**

Regions in the complex plane.

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.

Chapter1- section 11.
Chapter2-sections12, 15,16, 18 to 22, 24, 25,26.
Chapter3-sections 29, 30, 33 to 36.

Module 2 **(25 hrs)**

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.
Chapter 4-sections 37to 41, 43, 44 ,46,48 to 54.

Module 3 **(15 hrs)**

Series
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 & 62.

Module 4 **(20 hrs)**
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.
Chapter 6-sections 68 to74 (except71).
Chapter 7-sections 78 to 81 & 85.

Learning Resources

Textbook

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

References

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

Competencies of the course:

- Distinguish complex variables and complex functions.
- Describe complex functions and identify them as transformations.
- Interpret the limit of complex functions.
- Interpret continuity at a point and continuity in a region of complex functions.
- Understand differentiability of complex functions.
- Recognize differentiability implies continuity but continuity need not imply differentiability.
- Describe Cauchy-Riemann equations, and use them to distinguish between differentiable and non-differentiable functions.
- Understand analytic functions and entire functions.
- Describe harmonic functions and utilize the property to verify differentiability.
- Know elementary functions and their properties.
- Understand the theory and techniques of complex integration.
- Recognize that contour integrals of complex functions are path dependent except in certain cases.
- Interpret Cauchy-Goursat Theorem, Cauchy's Integral formula, Cauchy's inequality Theorem, Liouvilles theorem, Maximum-Modulus principle and apply these properties for integration.
- Understand the theory and application of the power series expansion of analytic functions.
- Derive power series expansion of analytic function using Taylor's theorem or Laurent's Theorem.
- Distinguish between singular points, non-singular points isolated singularities an d non-isolated singularities.
- Characterise singularities.
- Evaluate residue of functions at isolated singular points.
- Calculate integrals of the form $\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$, $\int_{-\infty}^{\infty} f(x)dx$, $\int_{-\infty}^{\infty} f(x)\cos x\, dx$ and $\int_{-\infty}^{\infty} f(x)\sin x\, dx$.

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MT6B10B- COMPLEX ANALYSIS

Module	Part A	Part B	Part C	Part D
I	3	2	2	1
II	1	3	2	2
III	0	2	2	0
IV	2	3	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CORE COURSE 11)
SIXTH SEMESTER

Name of the Course: MT6B11B-FUZZY MATHEMATICS

Duration: One Semester

Credits: 4 credits

Total Lecture Hours: 90 (5hours/week)

Aims: Among the various paradigmatic changes in science and mathematics one such change concerns the concept of uncertainty. The crisp set is defined in such a way as to dichotomize the individuals in some given universe of discourse into two groups. However, many classification concepts we commonly employ and express in natural language describe sets that do not exhibit this characteristic. A fuzzy set can be defined mathematically by assigning to each individual in the universe of discourse a value representing its grade of membership in the fuzzy set. The course aims to define fuzzy sets, describe the basic concepts and properties of fuzzy sets, explain fuzzy intersection, union and complements, compute fuzzy arithmetic operations and introduce fuzzy logic.

Course Overview and Context:

.This course introduces the basic concepts of fuzzy set theory. A systematic study of the properties and operations on fuzzy sets is done. Fuzzy numbers and the arithmetic operations on fuzzy numbers are also discussed. An introduction to fuzzy logic is also included.

Syllabus Content

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

(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), 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)

Learning Resources:

Text books:

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

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.

Competencies of the course.

- recognize the meaning and significance of the emergence of fuzzy set theory.
- analyze different types of fuzzy sets
- examine connections between fuzzy sets and crisp sets
- explain how classical mathematical functions can be fuzzified
- compute fuzzy arithmetic operations
- acquire a basic foundation of fuzzy set theory and fuzzy logic.

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MT6B11B-FUZZY MATHEMATICS

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	1	3	2	1
III	1	2	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME
MATHEMATICS (CORE COURSE 12)
SIXTH SEMESTER

Name of the Course: MT6B12B- LINEAR ALGEBRA
Duration: One Semester
Credits: 4 credits
Total Lecture Hours: 90 (5 hours/week)

Aims: In the latter half of the twentieth century no area of mathematics has been more successful than that of Linear Algebra. Linear Algebra has wide applications in mathematical modelling in economics, operations research, stochastic process and probability theory. Many of the concepts of Linear Algebra are abstract. This course aims to introduce the students to formal deductive analysis, formulation of proofs and sharpen the logical reasoning skills.

Course Overview and Context:

The Matrix is the most concrete structure in Linear Algebra. This course revises the concepts of Matrix Algebra. Vector spaces and concepts of basis and dimension which lay the foundations of Linear algebra are introduced. Properties of linear transformations, Eigen values, Eigen vectors and Euclidean inner product are covered in detail.

Syllabus Content

Module 1 **(25 hrs)**

Review- Matrices
Vector spaces: Vectors, Subspace, Linear Independence, Basis and Dimension, Row Space of a Matrix.
(Chapter – 1, 2 Sections 2.1, 2.2, 2.3, 2.4, 2.5of text 1)

Module 2 **(30 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 3 **(20 hrs)**

Eigen vectors and Eigen values, properties of Eigen values and vectors, Diagonalization of Matrix
(Chapter 4 Sections 4.1,4.2,4.3)

Module 4 **(15 hrs)**

Euclidean Inner product-orthogonality
(Chapter: -5, Sections 5.1)

Learning Resources:

Text Book :

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

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.

7 Singaravalu - Differential Equations, Fourier Series and Laplace Tranforms

8 Hanna, J.R and J.H Rowland, Fourier Series, Transforms and Boundary Value Problems, 2nd Ed. New York, Wiley,1990.

Competencies of the course:

- Define vector spaces and sub spaces
- Differentiate between linearly independent and linearly dependent set of vectors
- Define span of a set.
- Illustrate the concept basis and dimension of vector spaces
- Define Linear transformations
- Determine matrix representations of linear transformations.
- Illustrate the properties of linear transformations.

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MT6B12B- LINEAR ALGEBRA

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	2	3	2	1
III	1	2	2	1
IV	1	2	2	1
Total	**6**	**10**	**8**	**4**

Syllabi Choice Based Courses

BACHELOR'S PROGRAMME

MATHEMATICS (CHOICE BASED (01))
SIXTH SEMESTER

Name of the Course: MT6B13aB-OPERATIONS RESEARCH
Duration: One Semester
Credits: 3 credits
Total Lecture Hours : 72 (4 hours/week)

Aims: Operations Research (OR) is a science which deals with problem, formulation, solutions and finally appropriate decision making. The programming which involves functions and constraints that are linear is popularly known as Linear Programming. It is one of the most widely used Operation Research (OR) tool. The main aim of this course is to present the different methods of solving Linear Programming problems. These methods are extensively used in different areas of Management, Business, Industry and in various other real life situations.

Course Overview and Context:

The present course examines the basic ideas about LPP and the different methods for solving them. An introduction to Queuing theory is also included.

Syllabus Content

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

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 **(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 **(22 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 **(20 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 inter arrival times (Exponential process) Distribution of departure (Pure Death Process) Distribution of Service Times.

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

Learning Resources:

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)

References:

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).

Competencies of the Course:

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

- 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.

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MT6B13aB-OPERATIONS RESEARCH

Module	Part A	Part B	Part C	Part D
I	1	2	2	0
II	1	3	2	2
III	2	3	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME

MATHEMATICS (CHOICE BASED (02))
SIXTH SEMESTER

Name of the Course: MT6B13bB - INTEGRAL TRANSFORMS
Duration: One Semester
Credits: 3 credits
Total Lecture Hours : 72 (4 hours/week)

Aims:

Laplace Transforms constitute an important tool in solving problems that involve differential equations. Applications of the theory of transforms and integrals are used in fields of Physics, Engineering and Applied Mathematics.

Fourier series constitute an important tool in solving problems that involve ordinary and partial differential equations. Applications of the theory of Fourier series, transforms and integrals are used in fields of Physics, Engineering and Applied Mathematics

Course Overview and Context:

An introduction to Laplace Transform and its applications in differential equations is discussed. Fourier series representations of periodic functions in terms of sine and cosine functions are introduced. Fourier transforms and integrals extend the ideas and techniques of Fourier series to non periodic functions. Methods to solve partial differential equations like heat and wave equations using Fourier integrals are also included.

Syllabus Content

Module 1 **(20 hrs)**
Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential Equations, Differentiation and Integration of Transforms, Convolution, Integral Equations, Partial Fractions, Systems of Differential Equations
(Section 5.1, 5.2, 5.4, 5.5, 5.6, 5.7)

Module 2 **(18 hrs)**
Fourier Series- Fourier Coefficients, Even and odd functions, Half range Expansions
(Chapter: - 10, Sections 10.1, 10.2, 10.3, 10.4)

Module 3 **(14 hrs)**
Fourier Integrals and Transforms- Fourier integrals, Fourier cosine and sine transforms
(Chapter: -10, Sections 10.8,10.9).

Module 4 **(20 hrs)**

Modelling: vibrating string, wave equations, Separation of variables, use of Fourier series, D' Alembert's Solution of the wave equation, heat equation: solution by Fourier integrals and transforms. (Chapter 11Sections 11.1, 11.2, 11.3, 11.4, 11.5, 11.6)

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Learning Resources:

Text Book :

1. Erwin Kreyzig – Advanced Engineering Mathematics- 8th Edition

Reference:

1. P.P.G Dyke -An Introduction to Laplace Transforms and Fourier Series,Springer (India) Pvt Ltd
2. D.V.Widder-The Laplace Transform, Dover Publications Inc
3. Singaravalu - Differential Equations, Fourier Series and Laplace Tranforms
4. Hanna, J.R and J.H Rowland, Fourier Series, Transforms and Boundary Value Problems, 2nd Ed. New York, Wiley,1990.

Competancies of the course.

- compute Laplace transforms of different functions.
- determine the solutions of differential equations by Laplace transform.
- compute Fourier series of periodic functions.
- evaluate Fourier integrals of functions.
- evaluate Fourier transforms of functions.
- understand the mathematical modeling of wave equations.
- understand the mathematical modeling of heat equations.
- find the solutions of partial differential equations using separation of variables.
- find the solutions using D' Alembert's method.
- find the solutions of heat equations using Fourier series.
- find the solutions of heat equations using Fourier integrals and transforms

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MT6B13bB - INTEGRAL TRANSFORMS

Module	Part A	Part B	Part C	Part D
I	3	3	1	1
II	1	2	2	0
III	1	2	2	1
IV	1	3	3	2
Total	**6**	**10**	**8**	**4**

SYLLABI- OPEN COURSES

MATHEMATICS (OPEN COURSE)

SYLLABUS

MATHEMATICS - OPEN COURSE
FIFTH SEMESTER

Name of the Course : MT5D01aB- APPLICABLE MATHEMATICS

Duration: One Semester

Credits: 4 credits

Total Lecture Hours : 72 (4 hours/week)

Aims: This course aims to prepare students of all streams, particularly those with arts and commerce back ground to approach competitive examinations and to prepare them for their higher studies. Short cut methods for solving problems are introduced to students, so that they can acquire better understanding of concepts and develop their problem solving skills.

Course Overview and Context:

Open Course is intended to equip students of other streams with the skills of problem solving and logical reasoning. This course introduces the concepts of quadratic equations ,Logarithms, Trigonometry, Heights and distances, Probability, Differential Calculus, Area and perimeter of polygons and Elementary Algebra. Knowledge in these areas of Mathematics are necessary for any graduate student to crack any competitive exam.

Syllabus Content

Module – 1 **(18 hrs)**

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 hrs)**

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)

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, Time and distance, Elementary mensuration – Area and perimeter of polygons
(Sections - 14, 15, 17, 18, 21).

Text Book

1. M. Tyra, & K. Kundan- Concepts Of Arithmetic, Bsc Publishing Company Pvt.Ltd.

Reference:

2. Aggarwal R.S - Quantitative Aptitude, S. Chand & Company Ltd,1989

Competencies of the Course:

- Illustrate the types of numbers
- Describe quadratic equations and its solutions
- Differentiate between permutations and combinations.
- Tabulate the trignometric ratios of different angles.
- Compute the heights and distances using trignometric functions
- Describe sample spaces and random events.
- Predict the probability of random events
- Use the rules of differentiation to find the derivatives of functions.
- Evaluate the indefinite and definite integrals of functions.
- Evaluate LCM and HCF of numbers
- Compute the squares, cubes, square roots and cube roots of numbers.
- Use ratio and proportion to solve problems
- Evaluate profit and loss of buying and selling problems
- Calculate the simple average of numbers from a given data.
- Estimate the Simple interest and compound interest on a principal amount.
- Solve problems involving concepts of time and work.
- Evaluate the problems related to work and wages.
- Find the area and perimeter of triangles, quadrilaterals and circles

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MT5D01aB- APPLICABLE MATHEMATICS

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	1	3	2	0
III	1	3	2	1
IV	2	2	2	2
Total	**6**	**10**	**8**	**4**

MATHEMATICS OPEN COURSE(02)
FIFTH SEMESTER

Name of the Course : MT5D01bB-MATHEMATICAL MODELLING
Duration: One Semester
Credits: 4 credits
Total Lecture Hours : 72 (4 hours/week)

Aims:

This course aims to give knowledge of the basic principles of mathematical modelling by analytical methods as well as by simulation using computers. On completion of this course the students will be able to form mathematical models from various areas of life which include :- Industry, Medicine, Physics, Chemistry, Biology, Astronomy etc.

Content And Course Over view:

Different types of models like Linear growth and decay models, Non-linear growth and decay models, Compartment models are discussed.

Characteristics of mathematical models, Mathematical modelling through geometry, algebra, trigonometry & calculus, Limitations of mathematical modelling are also included.

Module-1

Introduction [18 Hrs]

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

[Chapter-1: Sections 1.1 to 1.9 of book [1]; Page Nos. 1-29]

Module-2

Modelling Through First Order [18 Hrs]

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

[Chapter-2: Sections 2.1 to2.6 of book [1]; Page Nos.30 -52.]

MODULE-3 :

System Simulation [18 Hrs]

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

[Chapter-1: Sections 1.1 to 1.7 & Chapter-2: Sections 2.1 to 2.6 and 2.9 of book [2]; Page Nos. 1-39.]

Module-4:

Discrete System Simulation **[18hrs]**

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

[Chapter-3: Sections 3.1 to 3.7 and Chapter-4: Sections 4.1 & 4.2 of book [2]; Page Nos. 40-76.]

Learning Resources:

Texts:

[1] Mathematical modelling- J.N.Kapoor, New Age International, 2001 Reprint.

[2] System simulation with digital computer- Narsing Deo, Prentice Hall of India, Sixth printing, 1996.

References

[1] System simulation – Geoffrey Gordon, Prentice Hall of India, Second edition.

[2] Mathematical modeling for industry and engineering- Thomas Svobodny, Prentice Hall.

[3] Mathematical modeling- F.R.Giordano, M.D.Weir&William P.Fox, Third edition.

[4] A practical course in differential and mathematical modeling- Ibragimov N.H, Alga Publications.

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MT5D01bB-MATHEMATICAL MODELLING

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	1	3	2	0
III	1	3	2	1
IV	2	2	2	2
Total	**6**	**10**	**8**	**4**

MATHEMATICS OPEN COURSE(03)

FIFTH SEMESTER

Name of the Course : MT5D01cB- FINANCIAL MATHEMATICS
Duration: One Semester
Credits: 4 credits
Total Lecture Hours : 72 (4 hours/week)

Module – 1 **(18hrs)**

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

Module – 2 **(18hrs)**

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

Module – 3 **(18hrs)**

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

Module – 4 **(18hrs)**

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

Learning Resources:

Text book

Mc Cutch eon and Scot Heinemann, *An introduction to the Mathematics of Finance*, Professional publishing

References:

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

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MT5D01cB- FINANCIAL MATHEMATICS

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	1	3	2	0
III	1	3	2	1
IV	2	2	2	2
Total	**6**	**10**	**8**	**4**

MATHEMATICS OPEN COURSE(04)
FIFTH SEMESTER

Name of the Course : MT5D01dB- MATHEMATICAL ECONOMICS
Duration: One Semester
Credits: 4 credits
Total Lecture Hours : 72 (4 hours/week)

Module I :

Demand and Supply Analysis **(18hrs)**
Utility and demand – the meaning of demand and quantity demanded – the law of demand – demand curve – market demand curve – reasons for the law of demand – slope of a demand curve – shifts in demand – demand function and demand curve – the meaning of supply – supply function – law of supply – slope of a supply curve – shifts in supply – market equilibrium – price elasticity of demand – measurement of price elasticity – arc elasticity of demand – cross elasticity of demand.
(Relevant sections chapters 5 and 7 of Text -1)

Module II:

Cost and Revenue Functions **(18hrs)**
Cost function: Average and marginal costs, Short run and long run costs, Shapes of average cost curves in the short run and long run and its explanation, Revenue function, Marginal revenue (MR) and Average Revenue (AR) functions, Relation between MR, AR and Elasticity of demand.
(Relevant sections of chapter 19 & 21 of Text - 1)

Module III:

Theory of Consumer Behaviour **(18hrs)**
Cardinal utility analysis – the Law of diminishing marginal utility – the Law of equi-marginal utility – Indifference curves – Ordinal utility – Indifference map – Marginal rate of substitution – Properties of indifference curves.
(Relevant sections of chapters 9 and 11 of Text -1)

Module IV:
Economic Applications of Derivatives **(18hrs)**
Economic Applications of Derivatives. Marginal, average and total concepts optimizing economic functions - Functions of several variables and partial derivatives, Rules of partial

differentiation, Second order partial derivatives, Optimization of multivariable functions, Constrained optimization with Lagrange multipliers, Significance of the Lagrange multiplier, Total and partial derivatives – total derivatives.

Marginal productivity, Income determination, multipliers and comparative statics, Income and cross elasticity of demand, Optimization of multivariable function in Economics constrained optimization of multivariable functions in Economics.

(Chapter 4 – Sections 4.7 and 4.8; chapter 5 and chapter 6 sections 6. 1 to 6.5 – of text 2).

Learning Resources

Text books:

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

References

1.Singh, Parashar, Singh --*Econometrics & Mathematical Economics*, S. Chand & Co. 1997.

2.R.G.D. Allen - Mathematical Analysis for Economists, Macmillan, ELBS.

3.Edward T. Dowling - Introduction to Mathematical Economics, Third edition, Schaum's Outline Series, TMH.

4.Henderson & Quandt - Microeconomic Theory: A Mathematical Approach, 3rd Edition, TMH.

5.Taro Yamane - Mathematics for Economists: An elementary survey. Second Edition, PHI.

6.Srinath Baruah - Basic Mathematics and its Application in Economics, Macmillan.

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MT5D01cB- FINANCIAL MATHEMATICS

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	1	3	2	1
III	1	3	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

ST. TERESA'S COLLEGE, ERNAKULAM

(AUTONOMOUS)

SYLLABI

FOR

COMPLEMENTARY COURSES

TO

PHYSICS AND CHEMISTRY

(Effective from 2015 admission onwards)

MATHEMATICS
(COMPLEMENTARY COURSES)
BACHELOR'S PROGRAMME

MATHEMATICS
(COMPLEMENTARY COURSE TO PHYSICS AND CHEMISTRY)
FIRST SEMESTER

Name of the Course : MT1CPC01B- CALCULUS
Duration: One Semester
Credits: 3 credits
Total Lecture Hours: 72 (4 hours/week)

Aims: Calculus has wide applications in the field of science, engineering and this course aims to examine the fundamental concepts of limits, differentiation and integration that has wide applications science, engineering and economics.

Course Overview and Context:

This course introduces the concepts of differentiation and integration. Various applications of differentiation and integration are also discussed.

Syllabus Content

Module 1 **(22hrs)**

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.

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

Module II **(15hrs)**

Applications of Derivatives:

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 **(15 hrs)**

Integral Calculus:

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 1V **(20 hrs)**

Application of Integrals

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)

Learning Resources:

Text Books:-

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

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. Shanti Narayan , P .K . Mittal :Integral Calculus (S. Chand & Company)
4. Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

Competencies of the Course:

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

- compute the limit of functions.
- compute the value of the derivative at a point algebraically using the (limit) definition.
- determine the expression for the derivative of elementary functions from the limit definition.
- identify the extreme values of a function and classify them as maxima, minima and saddle points using the first derivative test.
- describe the consequences of Rolle's theorem and Mean Value theorem for differentiable functions.
- calculate integrals of functions.
- interpret the definite integral as the limit of a Riemann sum.
- determine area between curves, length of plane curves using integration.
- calculate volumes by slicing and rotation.
- compute areas of surfaces of revolution.

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MT1CPC01B- CALCULUS

Module	Part A	Part B	Part C	Part D
I	2	3	2	1
II	1	2	2	1
III	1	2	2	1
IV	2	3	2	1
Total	**6**	**10**	**8**	**4**

Model Question Paper

FIRST SEMESTER

MT1CPC01B- CALCULUS

(COMPLEMENTARY COURSE TO PHYSICS AND CHEMISTRY)

Time: 3 hrs. Max. Marks: 80

Part A

(Answer all questions. Each question carries 1 mark)

1. Find $\lim_{x\to 1}\frac{x^3-1}{x^2-1}$.
2. Differentiate $e^x\cos(5x+3)$ w.r.t x
3. State Rolle's Theorem.
4. Let $\int_0^2 f(z)\,dz = 3$ and $\int_2^4 f(z)\,dz = 7$. Find $\int_0^4 f(z)\,dz$.
5. Find $\int_0^3 \sqrt{y+1}\,dy$
6. If $(3-x^3) \le g(x) \le 3\cos x$ for all x, then $\lim_{x\to 0} g(x) =$ _____.

(6x1=6)

Part B

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

7. Prove that for any function f(x), if $\lim_{x\to c}|f(x)| = 0$, then $\lim_{x\to c} f(x) = 0$.
8. If $f(x) = \frac{1}{x}$, $x_0 = 4, \in = 0.05$ and $L = \frac{1}{4}$ find $\delta > 0$ such that

   $0 \le |x - x_0| < \delta \Rightarrow |f(x) - L| < \in$.
9. Differentiate $\log(x^2e^{mx})$ w.r.t x.
10. Find the value of c as in the Mean Value Theorem for the function in $f(x) = x^2+2x-1$ in [0, 1].
11. Find the critical points and determine the local extreme values of $y = x^{2/3}(x+2)$.
12. Show that the value of $\int_0^{\frac{\pi}{2}} \sqrt{\sin x}\,dx$ is less than $\frac{\pi}{2}$.
13. Give an example of a non-integrable function on [0,1].

14. Find the volume of the solid generated by revolving the region between the $Y-$ axis and the curve $x = 2\sqrt{y}\,, 0 \le y \le 4$ about $Y-$ axis.
15. Find the length of the circle of radius r defined parametrically by $x = r\cos t\,, y = r\sin t\,, 0 \le t \le 2\pi.$
16. Find the area of the region between the curve $y = 3x$ and the $X-$ axis over the interval $[0, b]$.

(7x2=14)

Part C

(Answer any five questions. Each question carries 6 marks)

17. Show that f(x) = $\begin{cases} x^2 \sin\frac{1}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$ is differentiable at x = 0 and find f '(0)
18. Using the definition of the limit of a function show that $\lim_{x\to 1} \frac{3x}{2} - 1 = \frac{1}{2}.$
19. Find the intervals on which the function g(t) = $-3t^2+9t+5$ is increasing and decreasing.
20. Identify the function's local extreme values and where they are assumed.
    f(x) = $2x - x^2$, $(-\infty < x \le 2)$
21. Find the average value of $f(x) = \sqrt{4-x^2}$ on $[-2, 2]$
22. State Mean Value Theorem for definite integrals. Show that if f is continuous on $[a, b]$; $a \neq b$ and if $\int_a^b f(x)\,dx = 0$, then $f(x) = 0$ at least once in $[a, b]$.
23. Find the length of $y = x^{\frac{3}{2}}$ from $x = 0$ to $x = 4$.
24. State Pappus Theorems for volumes and surface areas.

(5x6=30)

Part D

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

25. Let f(x) = $\begin{cases} 3 - x & x < 2 \\ \frac{x}{2} + 1 & x > 2 \end{cases}$

a) Find $\lim_{x \to 2^+} f(x)$ and $\lim_{x \to 2^-} f(x)$.

b) Does $\lim_{x \to 2} f(x)$ exist? Justify.

c) Find $\lim_{x \to 4^+} f(x)$ and $\lim_{x \to 4^-} f(x)$.

d) Does $\lim_{x \to 4} f(x)$ exist? Justify.

26. (a) State and prove Rolle's Theorem.

(b) Verify Rolle's theorem for the function $f(x) = 4 - x^2$ and $x \in [-2, 2]$

(c) Examine whether Rolle's theorem can be applied to a function $f(x) = \sin x$ for the interval $[0, \pi]$

27. Find the volume of the solid generated by revolving the region bounded by $y = x^2$ *and* $y = 1$, about a) the line $y = 1$ b) the line $y = 2$ c) the line $y = -1$

28. a)Find the area of the region between the $X-$ axis and the graph of $f(x) = x^3 - x^2 - 2x$, $-1 \leq x \leq 2$

b)Find the area between the graph of $f(x) = \sin x$ and the X axis over $[0, 2\pi]$

(2x15=30)

BACHELOR'S PROGRAMME

MATHEMATICS
(COMPLEMENTARY COURSE TO PHYSICS AND CHEMISTRY)
SECOND SEMESTER

Name of the Course: MT2CPC02B -PARTIAL DERIVATIVES, MULTIPLE INTEGRALS, TRIGONOMETRY AND MATRICES

Duration: One Semester
Credits: 3 credits
Total Lecture Hours : 72 (4 hours/week)

Aims: This course aims to provide the mathematical language needed for applying the concepts of calculus to numerous applications in science and engineering. Theory of matrices is extensively used in Economics, Linear Algebra and Stochastic Process. This course provides an introduction to matrix theory.

Course Overview and Context:

This course introduces the methods to calculate double integrals and triple integrals and use them to calculate volume of region in space. A detailed study about the matrix theory is done. Partial derivatives of functions and Trigonometric expansions are the other topics discussed in this course.

Syllabus Content:

Module I

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 II

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 3)

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 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).

Learning Resources:

Text Books:-

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. Frank Ayres Jr : Matrices, Schaum's Outline Series, TMH Edition.
3. S.L.Loney– Plane Trigonometry Part – II, AITBS Publishers India, 2009

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)

Competencies of the Course:

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

- interpret double integrals as the limit of a Riemann sum.
- calculate double integrals using polar coordinates.
- compute triple integral of a function.
- calculate partial derivatives of functions of several variables.
- calculate the rank of a matrix.
- compute summation of infinite series.
- solve system of equations using Matrix method.

- determine the characteristic roots and characteristic vectors of a Matrix.

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MT2CPC02B -PARTIAL DERIVATIVES, MULTIPLE INTEGRALS, TRIGONOMETRY AND MATRICES

Module	Part A	Part B	Part C	Part D
I	1	2	2	1
II	2	3	2	1
III	1	2	2	1
IV	2	3	2	1
Total	**6**	**10**	**8**	**4**

MODEL QUESTION PAPER

SECOND SEMESTER-

MT2CPC02B -PARTIAL DERIVATIVES, MULTIPLE INTEGRALS, TRIGONOMETRY AND MATRICES
(COMPLEMENTARY COURSE TO PHYSICS AND CHEMISTRY)

Time: 3 Hours **Maximum: 80 Marks**

Part A

(Short Answer Questions)

(Answer **all** questions. Each question carries 1 mark.)

1. Evaluate $\int_{-1}^{0}\int_{-1}^{1} x + y + 1 dxdy$.
2. Write the expansion of log (1+x).
3. $x - \frac{x^3}{3} + \frac{x^5}{5} - \ldots\ldots = \_\_\_\_\_$.
4. Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ where $f(x,y) = 2x^2-3y- 4$.
5. Find rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \end{bmatrix}$.
6. Find rank of $\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 2 & 1 \\ 1 & 3 & 1 & 1 \end{bmatrix}$.

(6x1=6 marks)

Part B

(Brief Answer Questions)

(Answer any **seven** questions. Each question carries 2 marks)

7. Calculate $\iint_R f(x, y)dA$ .for $f(x, y) = 1 - 6x^2 y$ and $R: 0 \le x \le 2, -1 \le y \le 1$
8. Evaluate $\int_1^e\int_1^e\int_1^e \frac{1}{xyz} dxdydz$.
9. If $u = \log \tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right)$, prove that $\tanh\frac{u}{2} = \tan\frac{\theta}{2}$.
10. If $\sin(\theta + i\phi) = r(\cos\alpha + i\sin\alpha)$, prove that $r^2 = \frac{1}{2}(\cosh 2\phi - \cos 2\theta)$.

11. If x is real show that $\cosh^{-1}x = \log\left(x + \sqrt{x^2 - 1}\right)$.
12. Verify that $w_{xy} = w_{yx}$ where w = ln (2x+3y).
13. Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ if $\sin(x + y) + \sin(y + z) + \sin(x + z) = 0$.
14. Reduce to normal form $\begin{bmatrix} 0 & 1 & 2 & 4 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 \end{bmatrix}$.
15. Show that the system of equations $\begin{matrix} \alpha + 2\beta = 3 \\ 2\alpha + 4\beta = 7 \end{matrix}$ is inconsistent.
16. Obtain the row equivalent canonical form of $\begin{bmatrix} 1 & 2 & -3 \\ 2 & 5 & -4 \end{bmatrix}$.

(7x2= 14 marks)

Part C

Descriptive (Short Essay questions)

(Answer any **five** questions. Each question carries 6 marks.)

17. Find the area enclosed by the cardioids $r = a(1 + \cos\theta)$.
18. Change the order of integration and evaluate the double integral $\int_0^1 \int_x^{2-x} \frac{x}{y} dydx$.
19. Sum the series $\sin^2\theta - \frac{\sin 2\theta}{2}\sin^2\theta + \frac{\sin 3\theta}{3}\sin^3\theta$ -……..
20. Prove that if $\tan\frac{\theta}{2} = \tanh\frac{u}{2}$, show that $u = \log\tan\left(\frac{\pi}{4} + \frac{\theta}{2}\right)$
21. Find f_x, f_y and f_z of 1).$\sin^{-1}(xyz)$, 2). $\cos^{-1}(xyz)$
22. Draw a tree diagram and write a chain rule formula for $\frac{\partial w}{\partial r}$ and $\frac{\partial w}{\partial s}$ for w = f(x, y), x = g(r), y= h(s).
23. Solve the following system
    $x + y + z = 6$
    $x - y + 2z = 5$
    $3x + y + z = 8$
24. Find the eigen vectors of the matrix $\begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$.

(5x6= 30 marks)

Part D

(Essay type questions)

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

25. Find the volume of the region D enclosed by the surfaces $z = x^2 + 3y^2$ and $z = 8 - x^2 - y^2$

26. Sum the infinite series $\cos\theta + \frac{1}{2}\cos 2\theta + \frac{1.3}{2.4}\cos 3\theta + \frac{1.3.5}{2.4.6}\cos 4\theta + \ldots$

27. a) If $z = f(x + ay) + \phi(x - ay)$. Prove that $\frac{\partial^2 z}{\partial y^2} = a^2 \frac{\partial^2 z}{\partial x^2}$.

b) If $z = \frac{\sin u}{\cos v}$ where $u = \frac{\cos y}{\sin x}$ and $v = \frac{\cos x}{\sin y}$. Find $\frac{\partial z}{\partial x}$.

28. Using Cayley Hamilton theorem, Show that $A^3 - 6A^2 + 11A - 6I = 0$, where $A = \begin{bmatrix} 1 & 1 & 2 \\ 0 & 2 & 2 \\ -1 & 1 & 3 \end{bmatrix}$ and hence find A^{-1}.

BACHELOR'S PROGRAMME

MATHEMATICS
(COMPLEMENTARY COURSE TO PHYSICS AND CHEMISTRY)
THIRD SEMESTER

Name of the Course : MT3CPC03B -VECTOR CALCULUS , DIFFERENTIAL EQUATIONS AND ANALYTIC GEOMETRY

Duration: One Semester
Credits: 4 credits
Total Lecture Hours : 90 (5 hours/week)

Aims: This course aims to provide the mathematical language needed for applying the concepts of Vector calculus to numerous applications in science and engineering. We need a mathematical description of three dimensional spaces to apply calculus in many real world situations. Vectors are used to study the analytic geometry of space, where they give simple ideas to describe lines, planes surfaces and curves in space.

Course Overview and Context:

This course introduces the methods of vector calculus to find the arc length and to find directional derivatives of curves. Various methods to solve differential equations included. A brief study on conic sections is also included.

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

(25hrs) 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)

Learning Resources:

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.

Reference Books :

1. Shanti Narayan , P .K . Mittal :Vector Calculus (S. Chand & Company)
2. P.P.G Dyke : An introduction to Laplace Transforms and Fourier Series (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.

Competencies of the Course

- Define vector valued functions
- Evaluate arc length of curves
- Evaluate the tangent and normal of a curve at a given point.
- Identify different types of differential equations.
- Solving 1st order differential equations.
- Framing equations different conic sections.
- Finding focus , directrix and eccentricity of conic sections.

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MT3CPC03B -VECTOR CALCULUS , DIFFERENTIAL EQUATIONS AND ANALYTIC GEOMETRY

Module	Part A	Part B	Part C	Part D
I	1	2	2	1
II	1	3	2	1
III	2	3	2	1
IV	2	2	2	1
Total	**6**	**10**	**8**	**4**

BACHELOR'S PROGRAMME
MATHEMATICS
(COMPLEMENTARY COURSE TO PHYSICS AND CHEMISTRY
FOURTH SEMESTER

Name of the Course: MT4CPC04B- FOURIER SERIES , PARTIAL DIFFERENTIAL EQUATIONS, NUMERICAL ANALYSIS AND ABSTRACT ALGEBRA

Duration: One Semester
Credits: 4 credits
Total Lecture Hours : 90 (5 hours/week)

Aims: Since the time of Isaac Newton differential equation have been of fundamental importance in the application of Mathematics to the Physical Science. Abstract Algebra is an important branch of Mathematics that has wide applications in almost all branches of Science. Algebra studies the structure of sets with operations on them. Numerical methods are gainfully employed by scientists and engineers to solve problems arising in research and industry. Fourier series constitute an important tool in solving problems that involve ordinary and partial differential equations. Applications of the theory of Fourier series , transforms and integrals are used in fields of Physics, Engineering and Applied Mathematics.

This course aims to provide the students with the basic topics of Fourier Series, Differential Equations, Numerical Analysis and Abstract Algebra so as to understand their role in modern mathematics and its applications to other fields.

Course Overview and Context:

This course deals with the basic concepts of abstract algebra and differential equations. Groups, rings, fields and vector spaces are the main topics covered under abstract algebra. Fourier series representations of periodic functions in terms of sine and cosine functions are introduced.In this course we are studying the ordinary differential equation involving one independent and one or more dependent variables. The integrals of ordinary differential equation are plane curves. Also we study the differential equation involving one dependent and more than one independent variable that are partial differential equation. This course also deals with different numerical methods for solving algebraic and transcendental equations.

Syllabus Content

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. (Theorems Statement only. Omit Proofs)

(Section 1.4, 1.5, 1.6, 2.8, 3.13, 4.18, 6.30 of text 4)

Learning Resources

Text Books:-

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

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, OxfordUniversity Press
6. Qazi Shoeb Ahamad, Zubir Khan – Numerical and Statistical Techniques, Ane Books

Competencies of the Course

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

- analyse various numerical methods
- find roots of equations by numerical methods
- compute Fourier series of periodic functions
- obtain orthogonal trajectories of families of curve son a given surface.
- find power series expansion about an ordinary point.
- describe the origin of partial differential equation
- solve Bessel's equations..
- solve the differential equation $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$
- define groups, rings and fields .
- explain different properties of groups.
- identify examples of groups, rings and fields.
- explain homomorphism and isomorphism of groups.
- describe cosets and factor groups.
- differentiate between the different algebraic structures.

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MT4CPC04B- FOURIER SERIES , PARTIAL DIFFERENTIAL EQUATIONS, NUMERICAL ANALYSIS AND ABSTRACT ALGEBRA

Module	Part A	Part B	Part C	Part D
I	2	2	2	1
II	1	3	2	1
III	1	2	2	2
IV	2	3	2	0
Total	**6**	**10**	**8**	**4**

SYLLABI

FOR

COMPLEMENTARY COURSES TO ECONOMICS

(Effective from 2015 admission onwards)

BACHELOR'S PROGRAMME

MATHEMATICS

(COMPLEMENTARY COURSE TO ECONOMICS)

FIRST SEMESTER

Name of the Course : MT1CE01B -GRAPHING FUNCTIONS, EQUATIONS AND FUNDAMENTAL CALCULUS

Duration: One Semester

Credits: 4 credits

Total Lecture Hours : 108 (6 hours/week)

Aims: The concepts of Mathematics are widely used in modern Economics. Mathematics is used as a tool to interpret and analyze data. Theories of Economics are formulated on the basis of Mathematical Principles. This course aims to familiarize students undergoing a course in Economics, the concepts of Mathematics and will lay a strong foundation to pursue their higher studies and research work.

Course Overview and Context:

This course introduces the concepts of polynomials, functions and equations. A detailed study of differentiation and integration of functions is also included. These topics are foundations of most areas of modern mathematics, and are applied frequently in Business and Economics .

Syllabus Content

MODULE-I **(20 Hrs)**

Review

Exponents, polynomials, factoring, fractions, radicals, order of mathematical operations. (Chapter 1 – 1.1,1.2,1.3,1.4,1.5,1.6)

Equations and Graphs

Equations, Cartesian Co-ordinate system, Linear Equations and Graphs, Slopes, Intercepts, The Slope- Intercept Form, Determining the equation of a straight line, Applications of Linear Equations in Business and Economics.(Chapter 2 – 2.1,2.2, 2.3,2.4,2.5,2.6,2.7,2.8)

MODULE-II (28Hrs)

Functions

Concepts and definitions, Graphing functions, the Algebra of Functions, Applications of linear functions for business and economics, Solving Quadratic Equations, Facilitating Non linear Graphing, Application of non linear functions in Business and Economics.
(Chapter 3 – 3.1,3.2, 3.3,3.4,3.5,3.6,3.7)

System of equations

Introduction, Graphical solutions, Supply-demand analysis, Break-even analysis, Elimination and substitution methods, IS-LM analysis, Economic and Mathematical modeling, Implicit functions and inverse functions.
(Chapter 4 – 4.1,4.2, 4.3,4.4,4.5,4.6,4.7,4.8,4.9)

Module – III (30Hrs)

Concepts of Limits:

Differential calculus (Fundamentals):

The derivative and the rules of differentiation: limits, continuity, The slope of curvilinear function. The derivative, differentiability and continuity, Derivative notation, Rules of differentiation, Higher order derivatives, Implicit functions, Differential calculus, Uses of derivatives. Increasing decreasing functions.Concavity and convexity.Relative extrema.Inflection points. Curve sketching. Optimisation of functions.The successive derivative test.Marginal concepts in economics.Optimising economic functions of business.Relation among total, marginal and average functions. Convex functions Quasi-Convex, Quasi – Concave functions
(Chapter 9 and 10

Module – IV **(30Hrs)**

Integral calculus (Fundamentals):

Integration rules for indefinite integrals. Area under a curve.The definite integral.The fundamental theorems of calculus. Properties of definite integrals. Area between curves.Integration by substitution. Integration by parts. Present value of cash flow consumers and producers surplus.

(Chapter 12)

Learning Resources

Text Books:-

1. Edward T Dowling : Theory and Problems of Mathematical Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993)

Reference Books :

1. Mary George, Pg Thomaskutty-Textbook Of Mathematical Economics, Published by Discovery Publishing House .

2. Singh, Parashar, Singh --*Econometrics & Mathematical Economics*, S. Chand & Co. 1997.

3. R.G.D. Allen - Mathematical Analysis for Economists, Macmillan, ELBS.

4. Edward T. Dowling - Introduction to Mathematical Economics, Third edition, Schaum's Outline Series, TMH.

5. Henderson & Quandt - Microeconomic Theory: A Mathematical Approach, 3rd Edition, TMH.

6. Taro Yamane - Mathematics for Economists: An elementary survey. Second Edition, PHI.

7. Srinath Baruah - Basic Mathematics and its Application in Economics, Macmillan.

8. H.L. Ahuja : Principles of Micro Economics, 15th Revised Edition, S. Chand.

9. G.S. Monga, Mathematics and Statistics for Economics, Vikas Publications, Second revised edition.

10. Simon and Blume, *Mathematics for Economists*: W W Norton and Company.

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Competencies of the Course

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

- explain the fundamental ideas of polynomials, functions and equations;
- analyze linear and nonlinear functions inbusiness and economics;
- explain the fundamental ideas of limit and continuity.
- introduce differentiation;
- calculate first and higher order derivatives :
- introduce integration of functions;
- evaluate the indefinite integrals of functions
- evaluate the definite integrals of functions using the fundamental theorem of calculus.
- calculate the area under a curve using integration.
- apply these mathematical concepts in Business and Economics.

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MT1CE01B -GRAPHING FUNCTIONS, EQUATIONS AND FUNDAMENTAL CALCULUS

Module	Part A	Part B	Part C	Part D
I	2	2	2	0
II	2	2	2	0
III	1	3	2	2
IV	1	3	2	2
Total	**6**	**10**	**8**	**4**

MODEL QUESTION PAPER

SECOND SEMESTER

MT1CT02B–GRAPHING FUNCTIONS, EQUATIONS AND FUNDAMENTAL CALCULUS

(COMPLEMENTARY COURSE (MATHEMATICS)FOR B.A ECONOMICS)

Time: 3 Hours **Maximum: 80 Marks**

Part A

(Short Answer Questions)

(Answer **all** questions. Each question carries 1 mark.)

1. Find $x^{-3/5}x^5$
2. What is the slope of the linear equation $x - y = 10$
3. If $f(x) = x^2 + 4x + 2$ and $g(x) = x^2 + 4$. Find $f(5) - g(1)$
4. Does the equation $y^2 = x$ represent a function?
5. Find $\lim_{x\to 2} \frac{x-2}{x^2-4}$
6. Evaluate $\int_a^b f(x)dx$ if $\int_b^a f(x)dx = k$.

(6x1=6 marks)

Part B

(Brief Answer Questions)

(Answer any **seven** questions. Each question carries 2 marks)

7. A firm has a fixed cost of Rs.7000/- for equipment and a variable cost of Rs.600/- for each unit produced. What is the total cost of producing 15 units of output?
8. Find the equation of the straight line passing through (5,3) and (1,-2).
9. Find the inverse function of $f(x) = 5x - 4$
10. Define the LM Schedule.
11. Find $\frac{d^2y}{dx^2}$ where $y = 10x^3 + 4x^2 - 20$

12. Check whether the function $f(x) = 5x^2 - 4x - 89$ is increasing or decreasing at $x = 2$

13. Find the average cost of $TC = Q^2 + 3Q + 55$ at $Q = 2$

14. Evaluate $\int (x^5 + 7x^{-2} + 3)dx$

15. Find the anti derivative of f(x) = $16(e^{2t} + 15e^{-3t})$ given the boundary condition $F(0) = 9$.

16. Find the total cost function TC given that the marginal cost function MC = $x^2 - 4x - 2$ and fixed cost of Rs 45 **(7x2= 14 marks)**

Part C

Descriptive (Short Essay questions)

(Answer any **five** questions. Each question carries 6 marks.)

17. Solve a) $\frac{240}{x-2} = \frac{576}{x+5}$ b) $\frac{x}{5} - 4 = \frac{x}{9} + 8$

18. Solve the simultaneous equations by elimination method

$5x + y = 2$

$x - 2y = 4$

19. Graph the function $f(x) = x^2 - 3$

20. Find the reduced form equation and hence find the equilibrium level of income given $Y = C + I + G, C = C_0 + bY, I = I_0, G = G_0$ where

$C = 125 + 0.8Y$, $I = 45$, $G = 90$

21. Find the successive derivatives of $y = 3x^4 - 15x^3 + 8x^2 - 6x + 5$

22. 22. Find $\frac{dy}{dx}$ where $y = \frac{6x^2 + 2x}{3x - 4}$

23.Evaluate $\int \frac{x^2}{\sqrt{x^3 - 3}} dx$

24.Find the consumer's Surplus CS for the demand curves P =148 - Q^2 , Q_0 =10, P_0 = 75.

(5x6= 30 marks)

Part D

(Essay type questions)

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

25. Use $MR = MC$ method to maximize profit π where $TR = 800Q - 7Q^2$

$TC = 2Q^3 - Q^2 + 80Q + 150$

26.Optimize the function $y = -2x^3 + 69x^2 + 1260x - 9$

27.Draw the graph and evaluate the area between the curves over the stated interval

$y_1=8-x^2$, $y_2=-x+6$ from x=-1 to x=2

28. Evaluate a) $\int \frac{-18x}{(x-7)^3} dx$

b) $\int 7xe^{x-3} dx$

c) $\int 20x(x+9)^4 dx$

MATHEMATICS (COMPLEMENTARY COURSE TO ECONOMICS)
SECOND SEMESTER

Name of the Course: MT2CE02B-EXPONENTIAL, LOGARITHMIC FUNCTIONS, LINEAR ALGEBRA AND ADVANCED CALCULUS

Duration: One Semester

Credits: 4 credits

Total Lecture Hours : 108 (6 hours/week)

Aims: The concepts of Mathematics are widely used in modern Economics. Mathematics is used as a tool to interpret and analyze data. Theories of Economics are formulated on the basis of Mathematical Principles. This course aims to familiarize students undergoing a course in Economics, the concepts of Mathematics and will lay a strong foundation to pursue their higher studies and research work.

Course Overview and Context:

This course introduces the concepts of exponential and logarithmic functions. An introduction to matrices and linear programming is also included. Another topic for study is the calculus of multi variable fumctions. These topics are foundations of most areas of modern

mathematics, and are applied frequently in Business and Economics .

Syllabus Content

Module – I **(20 Hrs)**

Exponential and logarithmic functions

Exponential functions. Logarithmic functions properties of exponents and logarithms. Natural exponential and logarithmic functions. Solving natural exponential and logarithmic functions. Logarithmic transformation of non linear functions. Derivatives of natural exponential and logarithmic functions. Interest compounding. Estimating growth rates from data points.

(Chapter 11)

MODULE-II **(36 Hrs)**

Linear (or Matrix) Algebra

Introduction, Definition and terms ,Addition and subtraction of matrices, Scalar multiplication. Vector multiplication, Multiplication of Matrices, Matrix expression of a system of Linear equations, Augmented matrix, Row operations, Gaussian method of solving linear equations.

(Chapter 5 – 5.1,5.2, 5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10)

Solving Equations With Matrix Algebra

Determinants and linear independence, Third order determinants, Cramer's rule for solving linear equations, Inverse matrices, Gaussian method of finding an inverse matrix, Solving linear equations with an inverse matrix, Business and Economic applications, Special Determinants.

(Chapter 6 – 6.1,6.2, 6.3,6.4,6.5,6.6,6.7,6.8)

MODULE-III **(20 Hrs)**

Linear programming using graphs:

Use of graphs, Maximisation using graphs, The extreme point theorem, Minimisation using graphs.

(Chapter 7 – 7.1,7.2, 7.3,7.4)

Module – IV **(32 Hrs)**

Calculus of Multivariable functions

Functions of several independent variables.Partial derivatives. Rules of partial differentiation . Second – order partial derivatives. Optimization of multivariable functions.Constrained optimization with Lagrange Multipliers.Income determination Multipliers. Optimization of multivariable functions in business and economics constrained optimization of multivariable economic functions. Constrained optimization of Cobb Douglas production functions. Homogeneous functions, homothetic functions and Eulers theorem

(Chapter 13 sections 1-10)

Learning Resources

Text Books:-

1. Edward T Dowling : Theory and Problems of Mathematical Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993).

Reference Books :

1. Mary George, Pg Thomaskutty-Textbook Of Mathematical Economics, Published by Discovery Publishing House .

2. Singh, Parashar, Singh --*Econometrics & Mathematical Economics*, S. Chand & Co. 1997.

3. R.G.D. Allen - Mathematical Analysis for Economists, Macmillan, ELBS.

4. Edward T. Dowling - Introduction to Mathematical Economics, Third edition, Schaum's Outline Series, TMH.

5. Henderson & Quandt - Microeconomic Theory: A Mathematical Approach, 3rd Edition, TMH.

6. Taro Yamane - Mathematics for Economists: An elementary survey. Second Edition, PHI.

7. Srinath Baruah - Basic Mathematics and its Application in Economics, Macmillan.

8. H.L. Ahuja : Principles of Micro Economics, 15th Revised Edition, S. Chand

9. Simon and Blume, *Mathematics for Economists*: W W Norton and Company.

10. G.S. Monga, Mathematics and Statistics for Economics, Vikas Publications, Second revised edition.

Competencies of the Course

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

- explain exponential and logarithmic functions;
- solve exponential and logarithmic functions.
- estimate growth rates from data points.
- determine partial derivatives of functions of several variables .

- compute the optimal solutions of economic and business problems using partial derivatives and Lagrange's multiplier method..
- introduce the concept of matrices;
- compute addition, multiplication and inverses of matrices.
- solve system of linear equations using matrices;
- introduce linear programming
- formulate linear programming problems using equations and inequalities.
- construct graphs and finding solutions to linear programming problems.
- apply these mathematical concepts in Business and Economics.

BLUE PRINT

MT2CE02B-EXPONENTIAL, LOGARITHMIC FUNCTIONS, LINEAR ALGEBRA AND ADVANCED CALCULUS

Module	Part A	Part B	Part C	Part D
I	2	2	1	1
II	2	3	3	1
III	0	2	2	1
IV	2	3	2	1
Total	**6**	**10**	**8**	**4**

MODEL QUESTION PAPER

SECOND SEMESTER

MT2CE02B-EXPONENTIAL, LOGARITHMIC FUNCTIONS, LINEAR ALGEBRA AND ADVANCED CALCULUS

(COMPLEMENTARY COURSE (MATHEMATICS) For B.A ECONOMICS)

Time: 3 Hours **Maximum: 80 Marks**

Part A

(Short Answer Questions)

(Answer **all** questions. Each question carries 1 mark.)

1. Convert into exponential form $\log_3 81 = 4$
2. Differentiate $y = e^{-5x}$ with respect to x
3. Write the identity matrix of dimension 3x3
4. Write down two 2x2 matrices A and B such that AB $\neq$ BA
5. Evaluate $\frac{\partial z}{\partial x}$ where $z = \frac{8x^3y^5}{x^2y^6}$
6. If $Q = 3 + 2P$, find $\frac{dP}{dQ}$.

(6x1=6 marks)

Part B

(Brief Answer Questions)

(Answer any **seven** questions. Each question carries 2 marks)

7. Differentiate $y = \ln(3x + 5)$
8. What is the domain and range of the exponential function $y = a^x, a > 0, a \neq 1$?
9. If $A = \begin{bmatrix} 8 & 3 \\ 2 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 4 \\ -6 & 5 \end{bmatrix}$. Find AB.
10. Define singular matrix. Give an example of a 3×3 singular matrix.
11. Express the following in matrix form

7x-4y +2z = 0, 8x -9z = 0

12. Find the number of basic solutions for a system of m consistent equations and n variables in linear programming , where n>m.
13. Convert the inequality constraints into equations by adding slack and surplus variables.

Maximize $\pi = 7x_1 + 21x_2$

Subject to
$$5x_1 + 2x_2 \le 40$$
$$3x_1 + 12x_2 \le 60$$
$$4x_1 + 8x_2 \le 48$$
$$x_1, x_2 \ge 0$$

14. If $z = 10e^{2x-y}$, find z_x and z_y.
15. Using implicit differentiation find the derivative $\frac{dy}{dx}$of $7x^6 + 4y^5 - 96 = 0$.
16. Find the second order derivative z_{xx} and evaluate z_{xx} at x = 1, y = 3, where $z = e^{(x^2+y^2)}$.

(7x2= 14 marks)

Part C

Descriptive (Short Essay questions)

(Answer any **five** questions. Each question carries 6 marks.)

17. Differentiate $f(x) = \left(e^{-5x} + e^{2x}\right)^3$
18. Solve the system of linear equations using Gaussian elimination method.

3x+8y = 53, 6x +2y = 50

19. Form the augmented matrix and find the inverse of the matrix using Gaussian method $A = \begin{bmatrix} 8 & 3 \\ 9 & 2 \end{bmatrix}$
20. Solve using Cramer's rule .

3x +8y +2z =67

4x +6 y + 9z = 36

7x + y +5 z = 49

21. Darken the feasible region of

$$\text{Minimize} \quad c = 7x_1 + 28x_2$$

$$\text{Subject to} \quad \begin{aligned} &3x_1 + 3x_2 \geq 24 \\ &5x_1 + x_2 \geq 20 \\ &x_2 \geq 2 \\ &x_1, x_2 \geq 0 \end{aligned}$$

22. A bakery makes Rs 4 profit on its wedding cakes X and Rs 3 on its birthday cakes Y, Wedding cakes take 4 minutes for mixing. 90 minutes for baking, and 8 minutes for icing. Birthday cakes take 6 minutes for mixing , 15 minutes for baking, and 4 minutes for icing. The bakery has 120 minutes of mixing time , 900 minutes of baking time, and 96 minutes of icing time. Express the data in terms of equations and inequalities necessary to determine the combination of wedding cakes and birthday cakes that will maximize the profit subject to the constraints.

23. Find the second order direct and cross partial derivatives z_{xx}, z_{yy} z_{xy} and z_{yx} where

$z = 4x^5 + 7xy + 8y^4$.

24. Use Lagrange's multiplier method to find the critical value of $z = 5x^2 - 2xy + 8y^2$ subject to the constraint x + y = 60

(5x6= 30 marks)

Part D

(Essay type questions)

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

25. Find the value A of a principal P=Rs.100/- set out at an interest rate r=12% for time t=1 year when compounded

a) Annually b)Semi-annually c)Quarterly d)Continuously

26. Use matrix inversion to solve the equilibrium level of income Y and the interest rate i

IS: $0.3\mathbf{Y} + 100\,\mathbf{i} - 252 = 0$ LM : $0.25\mathbf{Y} - 200\,\mathbf{i} - 193 = 0$

27. Solve graphically the linear programming problem

$$\text{Maximize} \quad \pi = 11y_1 + 10y_2$$

$$\text{Subject to} \quad \begin{aligned} 2y_1 + 3y_2 &\le 48 \\ 4y_1 + 12y_2 &\le 168 \\ 8y_1 + 6y_2 &\le 144 \\ y_1, y_2 &\ge 0 \end{aligned}$$

28. Use Lagrange's multiplier method to optimize the function $z = x^2 + 5xy + y^2$ subject to the constraint $x + y = 22$.

(2x15=30 marks)