UNIVERSITY OF CALICUT

B.Sc. DEGREE PROGRAMME
CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS UG)
MATHEMATICS (CORE COURSE)

SYLLABUS

(effective from 2009 admission onwards)

The courses for the UG Programme are framed using time tested and internationally popular text books so that the courses are at par with the courses offered by any other reputed universities around the world.

Only those concepts that can be introduced at the UG level are selected and instead of cramming the course with too many ideas the stress is given in doing the selected concepts rigorously. The idea is to make learning mathematics meaningful and an enjoyable activity rather than acquiring manipulative skills and reducing the whole thing an exercise in using thumb rules.

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

Duration of the degree programme shall be six semesters distributed in a period of three academic years. Each semester shall have a minimum of 90 working days inclusive of all examinations.

Some topics in the theory of equations are selected and left for students to learn by themselves. These are given at the end of the syllabus for the courses (MM1B01, MM3B03, MM4B04 of first, third and fourth semesters) as seminar topics. Students can make use of books and materials available in the web to prepare for the presentation. It is imperative that these are taken as part of the syllabus. These should be included in the internal examination. However they are not to be included for the university examinations. Few topics are listed at the end of the syllabus of some courses, which are complementary to the respective courses. They are to be treated similarly.

Every student has to do a project during the 5^{th} and 6^{th} semester. The topics for the project can be selected as early as the beginning of the 3^{rd} semester. It is mandatory that the students use the softwares they learned in the second semester for documentation. The project report shall be submitted at the end of the 6^{th} semester.

EVALUATION

The evaluation scheme for each course shall contain two parts: (i) Internal evaluation (ii) External evaluation. 25% weight shall be given to internal evaluation and 75% weight for external evaluation.

Weightage of internal and external evaluation

Evaluation	Weightage
Internal	1 (25%)
External	3 (75%)

Both internal and external evaluation will be carried out using direct grading system.

Components of internal evaluation

	Weightage	Grading
Assignment	1	Graded as A, B, C, D, E depending on quality.
Test paper (Best 2 out of 3)	2	Graded as A, B, C, D, E
Attendance	1	90% and above : A, 85-89% : B, 80-84% : C, 75-79% : D, Below 75% : E.
Seminar	1	Graded as A, B, C, D, E depending on presentation.

To ensure transparency of the evaluation process the internal assessment grade awarded to the student in each course in a semester shall be notified in the notice board at least one week before the commencement of the external examination. There shall not be any chance for improvement for internal grade.

The course teacher(s) shall maintain the academic record of each student registered for the course which shall be forwarded to the university (with the signature of the course teacher and HOD) through the Principal of the college.

The external evaluation of each course will be based on the university examination at the end of each semester.

The minimum requirement of attendance during a semester shall be 75% for each course. Attendance shall be maintained by the concerned course teacher. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of two times during the whole period of the degree programme may be granted by the university.

Benefits of attendance may be granted to students who attend University Union activities, meetings of University Bodies and participation in extra curricular activities by treating as present for the days of their absence for the above purpose on production of participation / attendance certificate in such activities issued by the University authorities / Principals subject to a maximum of 10 days in a semester.

There shall be a Department level Grievance Redressal Committee comprising of course teacher and one senior teacher as members and the HOD as the Chairman. This Committee shall address all grievances relating to the internal assessment grading of the students.

There shall be a college level Grievance Redressal Committee comprising of two senior teachers and two staff council members (one shall be elected member) as members and Principal as the Chairman.

An aggregate of C grade (external and internal put together) is required in each course for a pass and also for awarding degree. A student who fails to secure a minimum grade for a pass in a course is permitted to write the examination along with the next batch.

A student who registered for the degree programme shall complete the programme within six years from the year of Registration.

In all other matters the Calicut University regulations for Choice Based Credit Semester System for under graduate curriculum shall apply.

DETAILS OF MATHEMATICS (CORE COURSE)

Sl. No.	Code	Semester	Title of the Course	Contact Hrs/Week	No. of Credit	Duration of Exam	Weigh-tage
1	MM1B01	1	Foundations of Mathematics	4	4	3 hrs	30
2	MM2B02	2	Informatics and Mathematical Softwares	4	4	3 hrs	30
3	MM3B03	3	Calculus	5	4	3 hrs	30
4	MM4B04	4	Calculus and Analytic Geometry	5	4	3 hrs	30
5	MM5B05	5	Vector Calculus	5	4	3 hrs	30
6	MM5B06	5	Abstract Algebra	5	4	3 hrs	30
7	MM5B07	5	Basic Mathematical Analysis	5	4	3 hrs	30
8	MM5B08	5	Numerical Methods	5	4	3 hrs	30
9		5	Open Course offered by other department	3	4	3 hrs	30
10		5	Project	2	--	--	--
11	MM6B09	6	Real Analysis	5	4	3 hrs	30
12	MM6B10	6	Complex Analysis	5	4	3 hrs	30
13	MM6B11	6	Differential Equations	5	4	3 hrs	30
14	MM6B12	6	Number Theory and Linear Algebra	5	4	3 hrs	30

Sl. No.	Code	Semester	Title of the Course	Contact Hrs/Week	No. of Credit	Duration of Exam	Weigh-tage
15	ELECTIVE COURSE*						
	MM6B13(E01)	6	Graph Theory	3	2	3 hrs	30
	MM6B13(E02)		Linear Programming and Game Theory**				
	MM6B13(E03)		C Programming for Mathematical Computing***				
16	MM6B14(PR)	6	Project	2	4	--	--

* In the 6th semester an elective course shall be chosen among the three courses (Code MM6B13(E01), MM6B13(E02), MM6B13(E03)).

** Students who have chosen Mathematical Economics as a Complementary Course in the first 4 semesters shall not choose Linear Programming and Game Theory MM6B13(E02) as the elective course.

*** Students who have chosen Computer Science / Computer Applications as a Complementary Course during the first 4 semesters shall not choose C Programming for Mathematical Computing (MM6B13(E03)) as the elective course.

Open Course for students of other departments during the Fifth Semester

Code	Title of the Course	No. of contact hrs/week	No. of Credit	Duration of Exam	Weightage
MM5D01	Mathematics for Physical Sciences	3	4	3 hrs	30
MM5D02	Mathematics for Natural Sciences	3	4	3 hrs	30
MM5D03	Mathematics for Social Sciences	3	4	3 hrs	30

PATTERN OF QUESTION PAPER

For each course the external examination is of 3 hours duration and has maximum weightage 30. The question paper has 4 parts. Part I is compulsory which contains 12 objective type / fill in the blanks multiple choice type questions set into 3 bunches of four questions. Each bunch has weightage 1. Part II is compulsory and contains 9 short answer type questions and each has weightage 1. Part III has 7 short essay type/paragraph questions of which 5 are to be answered and each has a weightage 2. Part IV contains three essay type questions of which 2 are to be answered and each has weightage 4.

Part	No. of Questions	No. of questions to be answered	Weightage
I (Objective type)	3 bunches of 4 questions	All	3x1 = 3
II (Short Answer)	9	All	9x1 = 9
III (Short Essay)	7	5	5x2 = 10
IV (Long Essay)	3	2	2x4 = 8

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

FIRST SEMESTER

(w.e.f.2010 admn.)

MM1B01: FOUNDATIONS OF MATHEMATICS

4 hours/week **4 credits** **30 weightage**

Aims

The course aims to:

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

Brief Description of the Course

This course introduces the concepts of sets and functions from a rigorous viewpoint, mathematical logic, and methods of proof. These topics underlie most areas of modern mathematics, and to be applied frequently in the succeeding semesters.

Learning Outcomes

On completion of this unit successful students will be able to:

- ∞ prove statements about sets and functions;
- ∞ analyze statements using truth tables;
- ∞ construct simple proofs including proofs by contradiction and proofs by induction;

Future needs Introduction

All Mathematics course units, particularly those in pure mathematics and computer programming.

Syllabus

Text Books

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

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

Module 1 (16 hours)

Set theory

Pre-requisites: Sets, subsets, Set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and the counting principle. Empty set, properties of empty set. Standard set operations. Classes of sets. Power set of a set (Quick review).

Syllabus: Cartesian product of two and more sets, relations. Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections (As in section 1.7 of Text book 1).

Relations: Product set, Relations (Directed graph of relations on set is omitted). Composition of relations, Types of relations, Partitions, Equivalence relations with example of congruence modulo relation, Partial ordering relations, n-ary relations. (As in Chapter 3 of text book 2 excluding 3.7).

Module 2 (22 hrs)

Functions

Pre-requisites: Basic ideas such as domain, co-domain and range of functions. Equality of functions, Injection, Surjection and Bijection (Quick review).

Syllabus: Identity function, constant functions, product (composition) of functions, theorems on one-one and onto functions, Mathematical functions, Recursively defined functions (As in Chapter 4 of text book 2).

Indexed collection of sets, Operations on indexed collection of sets (As in 5.1, 5.2 and 5.3 of text book 2).

Special kinds of functions, Associated functions, Algorithms and functions,

Complexity of Algorithms (As in Chapter 5.7 of text book 2).

Equipotent sets, Denumerable and countable sets, Cardinal numbers (Definitions and examples only as in 6.1, 6.2, 6.3 and 6.5 of text book 2).

Module 3(22hrs.)

Basic Logic-1

Pre-requisite: Nil.

Syllabus: Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, Quantifiers, Binding variables and Negations.

(As in Chapter 1 of Text book 1).

Module 4 (12 hrs.)

Basic Logic-2

Methods of proof: Rules of inference, valid arguments, methods of proving theorems; direct proof, proof by contradiction, proof by cases, proofs by equivalence, existence proofs, uniqueness proofs and counter examples. (As in Chapter 1 of Text book 1).

References

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

E. Kamke, Theory of Sets, Dover Publishers.

Seminar Topics

Statement of fundamental theorem of Algebra: A polynomial equation of degree $n \geq 1$ has n and only n roots, relation between roots and coefficients, symmetric functions of the roots.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

SECOND SEMESTER

(w.e.f. 2010 admn.)

MM2B01 : INFORMATICS AND MATHEMATICAL SOFTWARES

4 hours/week **4 credits** **30 weightage**

Aim of the course

To update and expand basic informatics skills and attitudes relevant to the emerging knowledge society and also to equip the students to effectively utilize the digital knowledge resources for their chosen courses of study.

Objectives of the course

1. To review the basic concepts & functional knowledge in the field of informatics.

2. To review functional knowledge in a standard mathematical packages and utilities.

3. To impart skills to enable students to use digital knowledge resources in learning.

4. To propagate importance of the use of open source softwares.

Course Contents

The course has Theory Part and Practical Part. Theory include:

1. Introduction of the software

2. Purpose and aim of the software

3. Study about the area of Mathematics it is being used.

4. The procedure to use the software.

5. Theory related with syntax involved.

6. Use of the software in mathematical situations.

The University will conduct the theory examination of 3 hour duration. Practical examination of one hour duration should be conducted internally and should be considered for internal evaluation. For internal evaluation one of the three tests should be a practical examination. Students should keep practical records. Half of the time allotted for the course is to be dedicated to practicals.

Practical Part

Students will be developing skills in these softwares by doing practicals. Teacher will demonstrate the software. Students will be given mathematical situations to use the software to handle it. Practicals will be restricted to using the theory in the context of mathematics.

Syllabus

Text Book :-Python for Education-Learning Maths and Physics using Python and writing them in Latex - Dr.Ajith Kumar B.P.
(free download from www.iuac.res.in/phoenix)

Module I(24 hrs.)

1. Introduction

Hardware Components, Software components, The user interface, High Level Languages
(sections 1.1 to 1.4of the Text.)

2. Programming in Python

Getting started with Python, Variables and Data Types, Operators and their Precedence, Python Strings, Python Lists, Mutable and Immutable Types, Input from the Keyboard, Iteration: while and for loops, Conditional Execution: if, elif and else,Modify loops:break and continue, Line joining,Functions, More on Strings and Lists, Python Modules, File Input/Output,Formatted printing, Exception Handling.
(sections 2.1 to 2.18 of the text)

Module II(18 hrs.)

1. Arrays and Matrices

The NumPy Module, Vectorized Functions
(sections 3.1 and 3.2 of the Text)

2. Numerical methods

Polynomials,Finding roots of an equation, Equation solving using matrices.
(sections 6.4 to 6.6 of the Text)

Module III(15hrs.)

Data visualization

The Matplotlib Module, Plotting mathematical functions, Famous Curves, 2D plot using colors,Meshgrids,3D Plots
(sections 4.1 to 4.3, 4.6,4.8 and 4.9 of the Text)

Module IV(15hrs.)

Typesetting using Latex

Document classes,Modifying Text,Dividing the document,Environments,Typesetting Equations, Arrays and matrices.
(sections 5.1 to 5.6 of the Text)

References: (1) Python Tutorial Release 2.6.1 by Guido Van Rossum ,Fred L Drake.Jr.
(free download from http://www.altway.com/resources/python/tutoria.pdf)

(2)http://www.scipy.org/Numpy_Example_List

(3)http://docs.scipy.org/doc/

(4)Latex-User's Guide and Manual-Leslie Lamport.(Pearson Education)

(5)Informatics and mathematical software-Part II
-An Introduction to Python and Latex-Pramod C.E
(Calicut University Central Co-op Stores)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

THIRD SEMESTER

MM3B03: CALCULUS

5 hours/week **4 credits** **30 weightage**

Text Book: Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Module I : (24 hrs)

3. Function quick review

4. Shifting graphs

1.1 Limit and continuity

1.2 The Sandwich theorem

1.3 Target values and formal definition of limits

1.4 Extensions of limit concept

1.5 Continuity

3.1 Extreme value of functions

3.2 The mean value theorem

3.3 The first derivative test for local extremum values

Module II (24 hrs)

3.4 Graphing with y' and y"

3.5 Limit as $x \to \pm \infty$

Assymptotes and dominant terms

3.6 Optimization

3.7 Linearization and differentials

4.5 Riemann sums and definite – integrals

4.6 Properties, area and the mean value theorem.

Module III (18 hrs)

4.7 The fundamental theorem

4.8 Substitution in definite integrals.

5.1 Areas between curves

5.2 Finding volumes by slicing

5.3 Volumes of solids of revolution (Disk method only)

Module IV (24 hrs)

5.5 Lengths of plane curves

5.6 Areas of surface of revolution

5.7 Moments and centres of mass

5.8 Work

References:

1. Anton : Calculus, Wiley.

2. S.K. Stein : Calculus with Analytic Geometry, McGraw Hill.

Seminar Topics

Clogging arteries, sensitivity, conversion of mass to energy

Cubic equation, biquadratic equations, Cardon's method, Ferraris method.

Fluid pressure and force

Basic pattern and other modelling applications

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

FOURTH SEMESTER

MM4B04 : CALCULUS AND ANALYTIC GEOMETRY

5 hours/week 4 credits 30 weightage

Text Book

Thomas & Finney : Calculus, 9th ed., LPE, Pearson Education.

Module I : Transcendental functions (15 hrs)

6.2 Natural logarithms

6.3 The Exponential function

6.4 a^x and $\log_a x$

6.5 Growth and decay (quick review)

6.6 L'Hopital's Rule

6.7 Relative rates of growth

6.10 Hyperbolic functions

Module II – Infinite Series (25 hrs)

8.1 Limits of sequence of numbers.

8.2 Theorems for calculating limits of sequences.

8.4 Infinite series

8.4 Integral test for series of non-negative terms

8.5 Comparison test for series of non negative terms

8.6 Ratio and root test for series of non negative terms

8.7 Alternating series, Absolute and conditional convergence

Module III (15 hrs)

8.8 Power series

8.9 Taylor and Maclaurin's series

8.10 Convergence of Taylor series

Error estimate

Module IV (35 hrs)

9.1 Conic section and quadratic equations

9.2 Classifying conic section by eccentricity

9.3 Quadratic equations and rotations

9.4 Parametrisation of plane curves

9.5 Calculus with parametrised curves

9.6 Polar coordinates

9.7 Graphing in polar co-ordinates

9.8 Polar equations for conic sections

9.9 Integration in polar coordinates.

References

Anton : Calculus, Wiley.

S.K. Stein : Calculus and Analytic Geometry, McGraw Hill.

Seminar topics

Reduction formula – for integration.

Transformations of equations – Reciprocal equations, Descartes' rule of signs, Sturm's theorem.

Application of power series (8.11)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

FIFTH SEMESTER

MM5B05 : VECTOR CALCULUS

5 hours/week **4 credits** **30 weightage**

Text Book: Thomas / Finney : Calculus, 9th ed., LPE, Pearson Education.

Module I (20 hrs)

(A quick review of Section 10.1 to 10.4)

10.5 Lines and planes in space.

10.6 Cylinders and Quadric surfaces

10.7 Cylindrical and spherical coordinates

11.1 Vector valued functions and space curves.

11.3 Arc length and Unit tangent vector

11.4 Curvature, torsion and TNB frame

Module II – Multivariable functions and Partial Derivatives (20 hrs)

12.1 Functions of several variables

12.2 Limits and Continuity

12.3 Partial derivatives

12.4 Differentiability linearization and differentials

12.5 Chain rule

12.6 Partial derivatives with constrained variables

12.7 Directional derivatives, gradient vectors and tangent planes

12.8 Extreme value and saddle points

12.9 Lagrange multipliers

12.10 Taylor's formula

Module III (20 hrs)

13.1 Double Integrals

13.3 Double integrals in polar form

13.4 Triple integrals in Rectangular Coordinates

13.6 Triple integrals in cylindrical and spherical co-ordinates.

13.7 Substitutions in multiple integrals.

Module IV – Integration in Vector Fields (30 hours)

14.1 Line integrals

14.2 Vector fields, work circulation and flux

14.3 Path independence, potential functions and conservative fields

14.4 Green's theorem in the plane

14.5 Surface area and surface integrals

14.6 Parametrized surfaces

14.7 Stokes' theorem (statement only)

14.8 Divergence theorem and unified theory (no proof).

References

1. 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.

Seminar topics

Modelling projectile motion (11.2)

Planetary motion and Satellite (11.5)

Area, moments and Centre of mass (13.2)

Masses and Moments in three dimension (13.5)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

FIFTH SEMESTER

MM5B06 : ABSTRACT ALGEBRA

5 hours/week **4 credits** **30 weightage**

Text Books:

1. John B. Fraleigh : A First Course in Abstract Algebra, 7th Ed., Pearson.
2. D. Prasad : Linear Algebra, Narosa Pub. House.

Module I (20 hrs)

Binary operations; Isomorphic binary structures; Groups; Sub groups

(Sections 2, 3, 4 & 5 of Text 1).

Module II (25 hrs)

Cyclic groups; Groups and permutations; Orbits, cycles and Alternating groups (Sections 6, 8, & 9 of Text 1).

Module III (15 hrs)

Cosets and Theorem of Lagrauge; Homomorphisms

(Sections 10 & 13 of Text 1).

Module IV (30 hrs)

Rings and Fields; Integral Domains

(Sections 18 & 19 of Text 1).

Vector spaces; Subspaces; Linear Dependence and Independence; Basis and Dimension

(Chapter 2 of Text 2).

References

1. Joseph A. Gallian : Contemporary Abstract Algebra. Narosa Pub. House.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul: Basic Abstract Algebra, 2nd ed., Cambridge University Press.
3. Artin : Algebra, PHI.
4. K. Hofman and R. Kunze : Linear Algebra, Pearson Education
5. J.B. Fraleigh & R.A. Beauregard : Linear Algebra, Addison Wesley.
6. Durbin : Modern Algebra : An Introduction, 5th ed., Wiley.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

FIFTH SEMESTER

MM5B07 : BASIC MATHEMATICAL ANALYSIS

5 hours/week **4 credits** **30 weightage**

Text 1 : Robert G. Bartle & Donald R. Sherbert : Introduction to Real Analysis, 3rd ed., Wiley.

Text 2 : J.W. Brown and Ruel V. Churchill : Complex Variables and Applications, 8th Ed., McGraw Hill.

Module I (20 hrs)

A quick review of sets and functions

Mathematical induction

Finite and infinite sets

Real Numbers

The algebraic property of real numbers

(Sec. 1.1, 1.2, 1.3, 2.1 of text 1)

Module II (20 hrs)

Absolute value and real line

The completeness property of R

Applications of supremum property

Intervals, Nested interval property and uncountability of R

(Sec 2.2, 2.3, 2.4 and 2.5 of text 1)

Module III (30 hrs)

Sequence of real numbers

Sequence and their limits

Limit theorems

Monotone sequences

Subsequence and Bolzano – Weirstrass theorem

Cauchy criterion

Properly divergent sequences.

Open and closed sets

(Sec. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 and 11.1 of text 1)

Module IV : Complex Numbers (20 hrs)

Sums and Products; Basic Algebraic properties; Further properties, Vectors and Moduli; Complex conjugates; Exponential form; Product and powers in

exponential form; Arguments of products and quotients; Roots of complex numbers; Regions in the complex plane.

(Sections 1 to 11 of Chapter 1 of Text 2)

References

1. J.M. Howie : Real Analysis, Springer 2007.
2. Ghorpade and Limaye : A Course in Calculus and Real Analysis, Springer, 2006.
3. K.A. Ross : Elementary Real Analysis : The Theory of Calculus, Springer Indian Reprint.
4. J.V. Deshpande : Mathematical Analysis and Applications, Narosh Pub. House.
5. M.R. Spiegel : Complex Variables, Schaum's Outline Series.

Seminar topics:

Expansions of sin $n\theta$, cos $n\theta$, $\sin^n\theta$, $\cos^n\theta$ etc. using de-Moivres theorem.

Sum of finite series like $\sin\theta + \sin 2\theta + ... + \sin n\theta$ etc.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

FIFTH SEMESTER

MM5B08 : NUMERICAL METHODS

5 hours/week **4 credits** **30 weightage**

Text :

S.S. Sastry : Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

Module I : Solution of Algebraic and Transcendental Equation (23 hrs)

2.1 Introduction

2.2 Bisection Method

2.3 Method of false position

2.4 Iteration method

2.5 Newton-Raphson Method

2.6 Ramanujan's method

2.7 The Secant Method

Finite Differences

3.1 Introduction

3.3.1 Forward differences

3.3.2 Backward differences

3.3.3 Central differences

3.3.4 Symbolic relations and separation of symbols

3.5 Differences of a polynomial

Module II : Interpolation (23 hrs)

3.6 Newton's formulae for intrapolation

3.7 Central difference interpolation formulae

3.7.1 Gauss' Central Difference Formulae

3.9 Interpolation with unevenly spaced points

3.9.1 Langrange's interpolation formula

3.10 Divided differences and their properties

3.10.1 Newton's General interpolation formula

3.11 Inverse interpolation

Numerical Differentiation and Integration

5.1 Introduction

5.2 Numerical differentiation (using Newton's forward and backward formulae)

5.4 Numerical Integration

5.4.1 Trapizaoidal Rule

5.4.2 Simpson's 1/3-Rule

5.4.3 Simpson's 3/8-Rule

Module III : Matrices and Linear Systems of equations (22 hrs)

6.3 Solution of Linear Systems – Direct Methods

6.3.2 Gauss elimination

6.3.3 Gauss-Jordan Method

6.3.4 Modification of Gauss method to compute the inverse

6.3.6 LU Decomposition

6.3.7 LU Decomposition from Gauss elimination

6.4 Solution of Linear Systems – Iterative methods

6.5 The eigen value problem

6.5.1 Eigen values of Symmetric Tridiazonal matrix

Module IV : Numerical Solutions of Ordinary Differential Equations (22 hrs)

7.1 Introduction

7.2 Solution by Taylor's series

7.3 Picard's method of successive approximations

7.4 Euler's method

7.4.2 Modified Euler's Method

7.5 Runge-Kutta method

7.6 Predictor-Corrector Methods

7.6.1 Adams-Moulton Method

7.6.2 Milne's method

References

1. S. Sankara Rao : Numerical Methods of Scientists and Engineer, 3rd ed., PHI.

2. F.B. Hidebrand : Introduction to Numerical Analysis, TMH.

3. J.B. Scarborough : Numerical Mathematical Analysis, Oxford and IBH.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

SIXTH SEMESTER

MM6B09 : REAL ANALYSIS

5 hours/week **4 credits** **30 weightage**

Text :

G. Bartle, Donald R. Sherbert : Introduction to Real Analysis (3rd Edn.).

Module I : Continuous Functions (25 hrs)

Continuous functions (a quick review)

Continuous functions on intervals

Uniform continuity

(Sec. 5.3, 5.4)

Module II : Riemann Integral (25 hrs)

Riemann Integral

Riemann Integrable Functions

The fundamental theorem

Substitution theorem and application

(Sec. 7.1, 7.2, 7.3 (upto 7.3.9)).

Module III : Sequence and series of functions (20 hrs)

A quick review of series of real numbers.

Pointwise and uniform convergence.

Interchange of limit and continuity.

Series of functions

(8.1, 8.2.1, 8.2.2, 9.4.1, 9.4.2, 9.4.5, 9.4.6)

Module IV (20 hrs)

Improper Integrals

Text: R.R. Goldberg : Methods of Real Analysis.

(Sections: 7.9, 7.10)

Beta and Gamma functions

Text: Narayanan & Manicavachagom Pillay : Calculus, Vol. II (Chapter IX, Sec: 2.1, 2.2, 2.3, 3, 4, 5)

References

1. J.V. Deshpande: Mathematical Analysis and Applications, Narosa Pub. House.
2. Torence Tao : Analysis I, TRIM 37, Hindustan Book Agency.
3. K.A. Ross: Elementary Real Analysis : Theory of Calculus, Springer.
4. K.G. Binmore: Mathematical Analysis, CUP.

Seminar Topics

Sequential criterion for limit of a function – divergence criteria – properties of limits using sequential criterion – squeeze theorem – Caratheodory's theorem for differentiable functions (Theorem 6.1.5), Chain rule (Theorem 6.1.6), Inverse function theorem (6.1.8 & 6.1.9); Taylor's theorem (Theorem 6.4.1) – Bolzano-Weierstrass theorem for bounded infinite sets – proof of nested intervals theorem using monotome sequence theorem – limit superior and limit inferior of sequence of real numbers (treatment as in R. Goldberg: Methods of Real Analysis).

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

SIXTH SEMESTER

MM6B010 : COMPLEX ANALYSIS

5 hours/week **4 credits** **30 weightage**

Text : James Ward Brown and Ruel V. Churchill : Complex Variables and Applications (8^{th} Edn.), McGraw Hill.

Module I : Analytic Functions (24 hrs)

Functions of complex variable, Limits Theorems on limits, Limits involving the points at infinity, Continuity derivatives, Differentiation formula, Cauchy-Riemann Equations, Polar coordinates, Analytic functions, Harmonic functions

(Sec: 12, 15 to 26 of Chapter 2)

Elementary functions

The exponential function, Logarithmic function, Complex exponents, Trigonometric functions, Hyperbolic functions, Inverse Trigonometric and Hyperbolic functions.

(Sec. 29 to 36 of Chapter 3)

Module II : Integrals (22 hrs)

Derivatives of functions $\omega(t)$; Indefinite integral of $\omega(t)$; Contours, Contour integrals, Antiderivatives, Cauchy-Goursat theorem (without proof), Simply and multiply connected domains, Cauchy's integral formula and its extension, Liouville's theorem and fundamental theorem of algebra, Maximum modulus principle.

(Sec: 37 to 54 excluding 42, 47 of Chapter 4)

Module III : Series (22 hrs)

A quick review of convergence of sequence and series of complex numbers.

Taylor series, Laurents series (without proof), Applications.

Power series: Absolute and uniform convergence. Continuity of sum of power series, Differentiation and integration of power series, Multiplication and division of power series.

(Sec: 55 to 60 & 62 to 67 of Chapter 5).

Module IV : Residues (22 hrs)

Isolated singular points, Residues, Cauchy's residue theorem, Residue at infinity, Three types of isolated singular points, Residues at poles, Zeroes of analytic functions, Zeroes and poles.

(Sec: 68 to 76 of Chapter 6).

Applications of residues

Evaluation of improper integrals, Jordan's Lemma (statement only), Definite integrals involving sines and cosines.

(Sec: 78, 79, 80 and 85 of Chapter 7).

References

1. Mark J.Ablowitz and Anthanassios S. Fokas: Complex Variables, Cambridge Text, 2nd Edn.
2. S. Ponnusamy : Foundation of Complex Analysis : Narosa.
3. Murray R. Spiegel: Complex Variables, Schaum's Outline series.
4. J.M. Howie: Complex Analysis: Springer India Reprint.
5. Stewart & Tall: Complex Analysis, CUP.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

SIXTH SEMESTER

MM6B11 : DIFFERENTIAL EQUATIONS

5 hours/week **4 credits** **30 weightage**

Text Book : W.E. Boyce & R.C. Diprima, Elementary Differential Equations and Boundary Value Problems. John Wiley & Sons, 7th Edn.

Module I (24 hrs)

(a) Introduction

1.1 Some Basic Mathematical Models; Direction Fields

1.2 Solutions of some Differential equations

1.3 Classification of Differential Equations

1.4 Historical Remarks

(Chapter 1, Sec. 1.1.1.2, 1.3, 1.4)

(b) First order differential equations

2.1 Linear equations with variable coefficients

2.2 Separable equations

2.3 Modeling with first order equations

2.4 Differences between linear and non linear equations

2.6 Exact equations and integrating factors

2.8 The existence and uniqueness theorem (proof omitted)

(Chapter 2 – Sec. 2.1, 2.2, 2.3, 2.4, 2.6, 2.8)

Module II (29 hrs)

(a) Second Order Linear Differential Equations

3.1 Homogeneous equation with constant coefficients

3.2 Fundamental solutions of Linear Homogeneous equations

3.3 Linear independence and Wronskian

3.4 Complex roots of characteristic equations

3.5 Repeated roots; Reudction of order

3.6 Non homogeneous equations; Method of Undetermined coefficients

3.7 Variation of parameters

3.8 Mechanical and Electrical vibrations (upto and including e.g. 1)

(Chapter 3 – Sec. 3.1 to 3.8)

(b) Systems of First Order Linear equations

7.1 Introduction

7.4 Basic theory of systems of first order Linear Equations

(Chapter 7 – Sec. 7.1, 7.4)

Module III : Laplace Transforms (17 hrs)

6.1 Definition of Laplace Transforms

6.2 Solution of Initial Value Problem

6.3 Step functions

6.5 Impulse functions

6.6 The Convolution Integral

(Chapter 6 – Sec. 6.1, 6.2, 6.3, 6.5, 6.6)

Module IV : Partial Differential Equations and Fourier Series (20 hrs)

10.1 Two point Boundary value problems

10.2 Fourier Series

10.3 The Fourier Convergence Theorem

10.4 Even and odd functions

10.5 Separation of variables; Heat conduction in a rod

10.7 The Wave equation: Vibrations of an elastic string

(Chapter 10 – Sec. 10.1, 10.2, 10.3, 10.4, 10.5, 10.7)

References

1. S.L. Ross : Differential Equations, 3rd ed., Wiley.
2. A.H. Siddiqi & P. Manchanda : A First Course in Differential Equation with Applications, Macmillan, 2006.
3. E.A. Coddington : An Introduction to Ordinary Differential Equation, PHI.
4. G.F. Simmons : Differential Equation with Application and Historical Notes, Second ed.
5. M. Braun : Differential Equations and their Applications, Springer.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE)

SIXTH SEMESTER

MM6B12 : NUMBER THEORY AND LINEAR ALGEBRA

5 hours/week **4 credits** **30 weightage**

Text Books:

1. David M. Burton : Elementary Number Theory, Sixth Edn., TMH.
2. Shanti Narayanan & Mittal : A Text Book of Matrices, Revised edn., S. Chand.

Module I – Theory of Numbers (30 hrs)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c.

Primes and their distribution. The fundamental theorem of arithmetic. The sieve of Eratosthenes. The theory of congruences. Basic properties of congruence. Binary and decimal representation of integers. Linear congruences and Chinese remainder theorem.

(Sections 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 4.2, 4.3 & 4.4 of Text 1).

Module II (25 hrs)

Fermat's little theorem and pseudoprimes Wilson's theorem. The sum and number of divisors. The greatest integer function. Euler's phi-function. Euler's generalization of Fermat's theorem. Properties of the phi-function.

(Sections 5.2, 5.3, 6.1, 6.3, 7.2, 7.3 and 7.4 of Text 1) (Theorems 7.6 and 7.7 only).

Module III (15 hrs)

Rank of a matrix – Elementary transformation, reduction to normal form, row reduced echelon form. Computing the inverse of a non singular matrix using elementary row transformation.

(Section 4.1 to 4.13 of Text 2)

Module IV (20 hrs)

System of linear homogeneous equations. Null space and nullity of matrix. Sylvester's law of nullity. Range of a matrix. Systems of linear non homogeneous equations.

Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorem. Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix Cayley-Hamilton theorem.

(Sections 6.1 to 6.6 and 11.1 to 11.3 and 11.11).

References

1. C.Y. Hsiung : Elementary Theory of Numbers. Allied Publishers.
2. Neville Robbins : Beginning Number Theory, Second Ed. Narosa.
3. George E. Andrews : Number Theory, HPC.
4. Kenneth Hoffman & Ray Kunze : Linear Algebra, Pearson Education.
5. Frank Ayres, Jr. : Matrices, Schaum's Outline Series, Asian Student edition.
6. Devi Prasad : Elementary Linear Algebra, Narosa Pub. House.

Seminar Topic

Linear Transformation and Matrices.

UNIVERSITY OF CALICUT

B.Sc. DEGREE PROGRAMME
CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS UG)
MATHEMATICS (CORE COURSE)
ELECTIVE COURSE
(DURING THE 6TH SEMESTER)

SYLLABUS

(effective from 2009 admission onwards)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (ELECTIVE COURSE)

SIXTH SEMESTER

MM6B01(E01) : GRAPH THEORY

3 hours/week **2 credits** **30 weightage**

Text Book : S. Arumugham & S. Ramachandran : Invitation to Graph Theory, Scitech Publications, Chennai-17.

AIM AND OBJECTIVE

In the last three decades graph theory has established itself as a worthwhile mathematical discipline and there are many applications of graph theory to a wide variety of subjects which include Operations Research, Physics, Chemistry, Economics, Genetics, Sociology, Linguistics, Engineering, Computer Science, etc.

Module I (17 hrs)

Isomorphic graphs, Ramsey numbers, Independent sets and Coverings, Intersection graphs and line graphs, Operation on graphs, Walks, Trials and Paths, Connected components, Blocks, Connectivity sections 2.4, 2.5, 2.6, 2.7, 2.9, 4.0, 4.1, 4.2, 4.3, 4.4.

Module II (10 hrs)

Eulerian and Hamiltanian graphs (omit Fleury's Algorithm) Trees

Sections : 5.0, 5.1, 5.2 (only upto and not including Theorem 5.5), 6.0, 6.1, 6.2.

Module III (10 hrs)

Matchings and Planarity

Sections 7.0, 7.1, 7.2, 8.0, 8.1, 8.2

Module IV (17 hrs)

Colourability, Chromatic numbers, Five colour theorem, Chromatic polynomials, Directed graphs, Paths and Connectedness.

Sections: 9.0, 9.1, 9.2, 9.4, 10.0, 10.1, 10.2.

References

1. R.J. Wilson: Introduction to Graph Theory, 4th ed., LPE, Pearson Education.
2. J.A. Bondy & U.S.R. Murty : Graph Theory with Applications.
3. J. Clark & D.A. Holton: A First Look at Graph Thoery, Allied Publishers.
4. N. Deo : Graph Theory with Application to Engineering and Computer Science, PHI.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (ELECTIVE COURSE)

SIXTH SEMESTER

MM6B01(E02) : LINEAR PROGRAMMING AND GAME THEORY

3 hours/week **2 credits** **30 weightage**

Text Book : Dipak Chatterjee : Linear Programming and Game Theory, Prentice Hall of India.

Module I (10 hrs)

Mathematical programming, Convexity, Basic solutions.

Chapter I, Chapter II (2.2, 2.5, Theorem 2.5.3, omitted 2.6).

Module II (16 hrs)

Simplex Method, Duality

Chapter III : 3.1 (Theorem 3.1.3 statement only), 3.2, 3.3, 3.4, 3.6

Chapter IV : 4.1, 4.2 upto and including Theorem 4.2.2.

Module III (14 hrs)

Transportation problems, Assignment problems

Chapter 9: 9.1, 9.2, 9.2.1, 9.2.2, 9.2.3, 9.3; Chapter 10: 10.1, 10.2, 10.3, 10.4 (a and b).

Module IV (14 hrs)

Theory of Games

Chapter 11 : 11.1, 11.2, 11.3, 11.4, 11.5

References

1. P.K. Gupta & Manmohan : Linear Programming & Theory of Games, Sultan Chand.
2. K.V. Mital & Mohan : Optimization methods in Operations Research and Systems Analysis, 3rd Ed., New Age International Publishers.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (ELECTIVE COURSE)

MM6B01(E03) : C PROGRAMMING FOR MATHEMATICAL COMPUTING

3 hrs / week **2 credits** **30 weightage**

Course Requirements:

Basic familiarity with computer.

A C compiler (Turbo C or Turbo C++) to do the Assignments in the course.

Course Goals

Students who complete this course will:

1. Have the basic skills required for computer programming.
2. Learn to write, compile and debug a C program
3. Be able to solve Mathematical problems using C programs
4. Introduce how to use C for drawing graphs and use mathematical models.

Course Contents

The course has Theory Part and Practical Part. The total periods for the course is 54 hrs of which 36 hrs for theory and 18 hrs for practical. Theory part focus on learning C Language to solve mathematical problems as listed in the Annexure 1. As and when various structures in C Language are discussed take examples from mathematics background as far as possible and conduct lab sessions to reinforce the idea. The Practical sessions are for testing the programs with the help of a C/C++ compiler. For entertaining free software, use Linux environment. A student must keep with the computer output obtained. He/She is expected to do a minimum of 12 programs selected from the list. (As shown in Annexure I) besides some other suitable sample programs to understand the style of C programming. The student has to maintain an observation note book and a practical record. Of the 3 periods per week 2 are for theory class and 1 is for practical session.

The University will conduct only theory examination, but Practical examination should be conducted internally and this should be considered for internal mark. For internal assessment minimum three tests, of which one should be practical test, may be conducted.

Theory Session (36 hrs)

Text Books

1. E. Balaguruswamy : Programming in Ansi C, Tata McGraw Hill.
2. Basavaraj S. Anami, Shanmughappa, A., Angadi S. & Sunilkumar S. Manvi – Computer Concepts and Programming (A Holistic Approach to Learning C), Prentice Hall of India.

Module I (9 hrs)

Program Fundamentals: Computer Languages – Operating System – Compilation of Program – Different Types of Errors – Debugging of programs – Rewriting and Program Maintenance – Program Life Cycle (Text Book 2 – A quick review of Chapter 1 section 1.5).

Algorithms and Flow Charts: Algorithms and their characteristics – Flow Charts and their Uses – Advantages and Drawbacks of Flow Charts. (A quick view of Text Book 2 – Chapter 2 – All sections).

Overview of C: History of C – Importance of C – Sample programs – Basic Structure of a C Program – Programming Style – Executing C Program – DOS System (Text Book 1 – Chapter 1 – Section 1.1 to 1.12).

Constants, Variables and Data Types: Introduction – Character set – Keywords and Identifiers – Constants – Variables – Data Types – Declaration of storage class – Declaration of variables (Primary and User defined) – Assigning Values to variables – Symbolic constants (Text Book 1 – Chapter 2 – Sections 2.1 to 2.13).

Module II (9 hrs)

Operators and Expressions: Introduction – Arithmetic operators – Relational operators – Logical operators – Increment and Decrement operators – Conditional Operators – Arithmetic Expression – Evaluation of Expressions – Precedence of Operators – Some Computational Problems – Type Conversions in Expressions – Mathematical Functions (Text Book 1 – Chapter 3 – Sections 3.1 to 3.7 and 3.10 to 3.16).

Managing Output Operations: Introduction – Reading and writing a character and a string – Formatted Input – Formatted Output – Use of %c, %d, %e, %f, %s – (Text Book 1 – Chapter 4 – Sections 4.1 to 4.5).

Module III (9 hrs)

Decision Making and Branching: Introduction – If Statements (Simple if, if-else, nested if, ladder if) – Switch Statement – Conditional Operator – Go to Statement (Text Book 1 – Chapter 5 – Sections 5.1 to 5.9).

Decision Making and Looping: Introduction – While Statement – Do-while Statement – For Statement – Use of break, goto, continue in control statements (Text Book 1 – Chapter 6 – Sections 6.1 to 6.5).

Module IV (9 hrs)

Arrays: Introduction – One Dimensional Arrays – Two Dimensional Arrays – Initialization of arrays – Multi Dimensional Arrays (Text Book 1 – Chapter 7 – Sections 7.1 to 7.9).

User Defined Functions: Introduction – Need for user defined functions – The form of C functions – Return of values – Calling a function – category of functions – Recursion – Function with arrays (Text Book 1 – Chapter 9 – Sections 9.1 to 9.10 and 9.16, 9.17, 9.18).

Reference Books

1. K.R. Venugopal & Sudeer R. Prasad : Programming with C, Tata McGraw Hill.
2. Yashhant Kanetkar : Let us C, BPB Publication.
3. Byron Gottereid : Programming with C, Tata McGraw Hill.
4. V. Rajaraman : Computer Programming, Prentice Hall of India.

Lab Sessions (18 hrs)

All the concepts in the theory sessions must be tested on a computer using a C compiler. A minimum of 12 problems from the list given in the Annexure I must be solved using C programming technique. A student should keep a practical record of the problem given by the teacher, algorithm, program and the output obtained in the lab session.

Practical Examination

The practical examination of 1 hour duration is only for internal assessment.

Annexure I

List of Numerical Problems

Section A (minimum 4)

1. Find GCD / LCM of two numbers.
2. Find the factorial of a number using recursion.
3. Check whether a number is prime or not
4. Reverse a n-digit number.
5. Find the sum of a set of numbers.
6. Write First n multiple of 7.
7. Find the maximum of two numbers using a function program.
8. Add two matrices / transpose a matrix.

Section B (minimum 5)

1. Find the maximum and the minimum of n numbers
2. Find the sum of the squares of first n natural numbers using loop
3. Find the number of above average student based on their mathematics marks

4. Multiply two matrices
5. Find the sum of digits of a n-digit number
6. Find the first n Fibonacci numbers
7. Evaluate Trigonometric / logarithmic / exponential function for a given x using its infinite series
8. Solve a given quadratic equation
9. Find the mean and standard deviation of a set of marks
10. Arrange a set of numbers in ascending / descending order.

Section C (minimum 3)

1. Integrate a function using trapezoidal rule
2. Solve a first order differential equation using Euler's method
3. Find a real root, if any, of polynomial equation using Bisection method.
4. Solve a first order differential equation using by Rung-Kutta method
5. Newton-Raphson's Method
6. Integrate a function using Simpson's rule.

UNIVERSITY OF CALICUT

CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS UG)
MATHEMATICS (OPEN COURSE)

(For students not having Mathematics as Core Course)

SYLLABUS

(effective from 2009 admission onwards)

CCSS UG PROGRAMME

MATHEMATICS (OPEN COURSE)

(for students not having Mathematics as Core Course)

FIFTH SEMESTER

MM5D01 : MATHEMATICS FOR PHYSICAL SCIENCES

3 hours/week **4 credits** **30 weightage**

Text Book:

1. John B Fraleigh : A First Course in Abstract Algebra, 7th ed., Pearson Ed.
2. Devi Prasad : Elementary Linear Algebra : Narosa.

Module I (30 hrs)

1. Binary operations
2. Isomorphic binary structures
3. Groups and subgroups - Sec. 2, 3, 4 and 5 of (1)
4. Groups of Permutations – Sec. 8 and 9 of (1)
5. Homomorphism – definition and simple examples – Sec. 13 of (1).
6. Rings and Fields – definition and simple examples.

Module II : Linear Algebra (24 hrs)

Vector space, subspace, linear dependence and independence.

Basis and dimension – simple examples

Linear transformations and matrix of linear transformations – simple examples (Text 2)

References

1. Joseph A. Gallian: Contemporary Abstract Algebra – Narosa Pub. House.
2. K. Hoffman & R. Kunze : Linear Algebra – Pearson Education.

CCSS UG PROGRAMME

MATHEMATICS (OPEN COURSE)

(for students not having Mathematics as Core Course)

FIFTH SEMESTER

MM5D02 : MATHEMATICS FOR NATURAL SCIENCES

3 hours/week **4 credits** **30 weightage**

Text :

Murray R. Spiegel : Statistics, 2nd Edn., Schaum's Outline Series.

Module I (30 hrs)

The idea of sets. Operation on sets. Relations and functions.

Variables and graphs (Chapter 1 of text 1).

Frequency distributions (Chapter 2 of text 1).

The Mean, Median, Mode and other measures of central tendency (Chapter 3 of text 1).

Dispersion or variation, The Range, The Mean deviation, The Semi-inter quartile range, Then 10-90 Percentile range; The standard deviation. Properties of standard deviation. The variance. Short methods of computing standard deviation (Relevant section of Chapter 4 of text 1).

Module II (24 hrs)

Moments, Moments for grouped data, relation between moments, Computation of moment for grouped data. Skewness and Kurtosis. (relevant sections of Chapter 5 from text 1).

Elements of Probability theory (Chapter 6 of text 1).

The Binomial distribution. The Normal distribution. Poisson distribution (Relevant sections from Chapter 7 of text 1)).

References

1. Hogg & Craig: Introduction to Mathematical Statistics.
2. Freund & Walpole: Mathematical Statistics.

CCSS UG PROGRAMME

MATHEMATICS (OPEN COURSE)

(for students not having Mathematics as Core Course)

FIFTH SEMESTER

MM5D03 : MATHEMATICS FOR SOCIAL SCIENCES

3 hours/week **4 credits** **30 weightage**

Text Book: Edward T. Dowling : Calculus for Business, Economics and Social Sciences, Schaum's Outline Series, TMH, 2005.

Module I : Equations and Graphs (27 hrs)

2.1 Equations

2.2 Cartesian Coordinate System

2.3 Graphing linear equations

2.4 The slope of art line

2.5 Solving linear equations simultaneously

2.6 Solving quadratic equations

2.7 Practical applications

Functions

3.1 Concepts and definitions

32. Functions and graphs

3.3 The Algebra of Functions

3.4 Applications of linear functions

3.5 Facilitating non-linear graphs

3.6 Applications of non-linear functions

The derivative

4.1 Limits

4.2 Continuity

4.3 Slope of a Curvilinear function

4.4 Rates of change

4.5 The derivative

4.6 Differentiability and Continuity

4.7 Application

Differentiation

5.1 Derivative rotation

5.2 Rules of differentiation

5.3 Derivation of the rules of differentiation

5.4 Higher order derivatives

5.5 Higher order derivative notation

5.6 Implicit differentiation

5.7 Applications

Module II : Uses of Derivative (27 hrs)

6.1 Increasing and decreasing functions

6.2 Concavity

6.3 Extreme points

6.4 Inflexion points

6.5 Curve sketching

Exponential and Logarithmic functions

7.1 Exponential functions

7.2 Logarithmic functions

7.3 Properties of exponents and logarithms

7.4 Natural exponential and Logarithmic functions

7.5 Solving natural exponential and logarithmic functions.

7.6 Derivatives of natural exponential and logarithmic functions.

7.7 Logarithmic differentiation

7.8 Applications of exponential functions

7.9 Application of Logarithmic functions

Integration

8.1 Antidifferentiation

8.2 Rules for indefinite integrals

Multivariable Calculus

9.1 Functions of several variables

9.2 Partial derivatives

9.3 Rules of partial differentiation

9.4 Second order partial derivatives

More of Integration

10.1 Integration by substitution

10.2 Integration by parts

References

1. Srinath Baruah : Basic Mathematics and its Applications in Economics, Macmillan.

2. Taro Yamane: Mathematics for Economists, Second ed., PHI.

UNIVERSITY OF CALICUT

B.Sc. DEGREE PROGRAMME
CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS UG)
MATHEMATICS
(COMPLEMENTARY COURSE)

SYLLABUS

(effective from 2009 admission onwards)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (COMPLEMENTARY COURSE)

FIRST SEMESTER

MM1C01 : MATHEMATICS

4 hours/week **3 credits** **30 weightage**

Text : George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.

Module I (24 hrs)

Limits and Continuity: Rules for finding limits. Target values and formal definitions of limits. Extensions of limit concept, Continuity, Tangent lines (Section 1.2, 1.3, 1.4, 1.5 & 1.6 of the Text).

Derivatives: The derivative of a function, a quick review of differentiation rules, rate of change. (Section 2.1, 2.2, 2.3 of the Text)

Module II (24 hrs)

Application of derivatives: Extreme values of a function. The mean value theorem, First derivative test, Graphing with y' and y''. Limits as $x \to \pm \infty$. Asymptotes and Dominant terms, Linearization and differentials. (Section 3.1, 3.2, 3.3, 3.4, 3.5, 3.7 of the Text).

Module III (12 hrs)

Integration: Riemann sums and Definite integrals; properties, areas and the Mean value theorem. The Fundamental theorem. (Section 4.5, 4.6, 4.7 of the Text).

Module IV (12 hrs)

Application of Integrals : Areas between curves, Volumes of Solids of Revolution (Disk method only), Lengths of plane curves. Areas of surfaces of revolution (Section 5.1, 5.2, 5.3, 5.5, 5.6 of the text), The L'Hopital's Rule (See section 6.6 of the Text).

References

1. S.S. Sastry, Engineering Mathematics, Volume 1, 4th Edition PHI.
2. Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (COMPLEMENTARY COURSE)

SECOND SEMESTER

MM2C02 : MATHEMATICS

4 hours/week **3 credits** **30 weightage**

Text: George B Thomas, Jr and Ross L Finney: CALCULUS, LPE, Ninth edition, Pearson Education.

Module I: Hyperbolic functions, Improper Integrals (10 hrs)

(Section 6.10, 7.6 of the Text)

Module II : Infinite Series (35 hrs)

Limit of Sequences of Number, Theorems for calculating limits of sequences, Infinite series, The integral test or Series of Non negative Terms, Comparison test for series of Nonnegative Terms, The ratio and root test for Series of Non negative Terms, Alternating series, Absolute and conditional convergence, Power Series, Taylor and Maclaurin Series.

(Sections 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9 of the Text)

Module III : Polar Coordinates (10 hrs)

Polar coordinates, Graphing in Polar Coordinates, Polar equations for conic sections, Integration in Polar coordinates, Cylindrical and Spherical Coordinates.

(Sections 9.6, 9.7, 9.8, 9.9, 10.7 of the Text)

Module IV : Multivariable Functions and Partial Derivatives (17 hrs)

Functions of Several Variables, Limits and Continuity, Partial Derivatives, differentiability, Chain rule, Directional derivatives, Gradient vectors and Tangent Planes.

(Sections 12.1, 12.2, 12.3, 12.4, 12.5, 12.7 of the Text)

References

1. S.S. Sastry, Engineering Mathematics, Volume I & II, 4th Edition PHI.
2. Murray R. Spiegel, Advanced Calculus, Schaum's Outline Series.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (COMPLEMENTARY COURSE)

THIRD SEMESTER

MM3C03 : MATHEMATICS

5 hours/week **3 credits** **30 weightage**

Text :

1. Erwin Kreyszig : Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. Frank Ayres JR : Matrices, Schaum's Outline Series, TMH Edition.

Module I : Ordinary Differential Equations (20 hrs)

Basic concepts and ideas, Geometrical meaning of y' = f(x,y). Direction Fields, Separable Differential Equations. Exact Differential Equations; Integrating Factors, Linear Differential Equations; Bernoulli Equation, Orthogonal Trajectories of Curves.

(Sections 1.1, 1.2, 1.3, 1.5, 1.6, 1.8 of Text 1).

Module II : Matrices (20 hrs)

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

Systems of Linear equations: Homogeneous and Non Homogenoeus Equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only) and simple applications (relevant sections of Text 2).

Module III : Vector Differential Calculus (25 hrs)

A quick Review of vector algebra, Inner product and vector product in $\mathbf{R}^2$ and $\mathbf{R}^3$. Vector and scalar functions and Fields, Derivatives, Curves, Tangents, Arc Length, Velocity and acceleration, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field.

(Sections 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.9, 8.10, 8.11 of Text 1).

Module IV : Vector Integral Calculus (25 hrs)

Line Integrals, Independence of path, Green's Theorem in the Plane (without proof), surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss and Stoke's theorem (without proofs).

(Sections 9.1, 9.2, 9.4, 9.5, 9.6, 9.7, 9.9, 9.10 of Text 1)

References

1. S.S. Sastry, Engineering Mathematics, Volume II, 4^{th} ed., PHI.

2. Shanthi Narayanan & P.K. Mittal, A Text Book of Matrices, S. Chand.

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.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (COMPLEMENTARY COURSE)

FOURTH SEMESTER

MM4C04 : MATHEMATICS

5 hours/week **3 credits** **30 weightage**

Texts:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. George B. Thomas, Jr. and Ross L. Finney, Calculus, LPE, Ninth Edition, Pearson Education.

Module I (20 hrs)

Linear Differential equations of Second and Higher order: Differential Operators, Euler-Cauchy Equation, Wronskian Nonhomogeneous Equations, Solutions by Undetermined Coefficients, Solution by variation of Parameters.

(Sections 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9, 2.10 of Text 1).

Module II (20 hrs)

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives of Integrals, Differential Equations. Unit step Function, Second Shifting Theorem, Dirac Delta Function, Differentiation and integration of Transforms, Convolution, Integral Equations, Partial Fractions, Differential Equations.

(Sections 5.1, 5.2, 5.3, 5.4, 5.5, 5.6 of Text 1 – excluding Proofs).

Module III (30 hrs)

Fourier Series : Periodic Functions, Trigonometric Series, Fourier Series, Even and Odd functions, Half-range Expansions.

(Sections 10.1, 10.2, 10.4 of Text 1 – Excluding Proofs).

Partial differential Equations: Basic Concepts, Vibrating String, Wave Equation, Separation of Variables, Use of Fourier Series.

(sections 11.1, 11.2, 11.3 of Text 1).

Module IV (20 hrs)

Numerical Methods: Methods of First-order Differential Equations (Section 19.1 of Text 1). Picard's iteration for initial Value Problems. (Section 1.9 of Text 1).

Numerical Integration: Trapezoidal Rule, Simpson's Rule. (Section 4.9 of Text 2).

References

1. S.S. Sastry, Engineering Mathematics, Vol. II, 4th ed., PHI.
2. Murray R. Spiegel, Advanced Calculus, Schaum's Outline Series.
3. Murray R. Spiegel, Laplace Transforms, Schaum's Outline Series.

PATTERN OF QUESTION PAPER

For each course the external examination is of 3 hours duration and has maximum weightage 30. The question paper has 4 parts. Part I is compulsory which contains 12 objective type / fill in the blanks multiple choice type questions set into 3 bunches of four questions. Each bunch has weightage 1. Part II is compulsory and contains 9 short answer type questions and each has weightage 1. Part III has 7 short essay type/paragraph questions of which 5 are to be answered and each has a weightage 2. Part IV contains three essay type questions of which 2 are to be answered and each has weightage 4.

Part	No. of Questions	No. of questions to be answered	Weightage
I (Objective type)	3 bunches of 4 questions	All	3x1 = 3
II (Short Answer)	9	All	9x1 = 9
III (Short Essay)	7	5	5x2 = 10
IV (Long Essay)	3	2	2x4 = 8

UNIVERSITY OF CALICUT

B.Sc. DEGREE PROGRAMME
CHOICE BASED CREDIT SEMESTER SYSTEM (CCSS UG)
MATHEMATICAL ECONOMICS
(COMPLEMENTARY COURSE)

SYLLABUS

(effective from 2009 admission onwards)

B.Sc. DEGREE PROGRAMME

MATHEMATICAL ECONOMICS (COMPLEMENTARY COURSE)

FIRST SEMESTER

ME1C01 : MATHEMATICAL ECONOMICS

4 hours/week **3 credits** **30 weightage**

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.

Module I : Demand and Supply Analysis (20 hrs)

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 (15 hrs)

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 (15 hrs)

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 (22 hrs)

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 6.6 – of text 2).

References

1. R.G.D. Allen : Mathematical Analysis for Economists, Macmillan, ELBS.
2. Edward T. Dowling : Introduction to Mathematical Economics, Third edition, Schaum's Outline Series, TMH.
3. Henderson & Quandt : Microeconomic Theory: A Mathematical Approach, 3rd Edition, TMH.
4. Taro Yamane : Mathematics for Economists: An elementary survey. Second Edition, PHI.
5. Srinath Baruah : Basic Mathematics and its Application in Economics, Macmillan.

B.Sc. DEGREE PROGRAMME

MATHEMATICAL ECONOMICS (COMPLEMENTARY COURSE)

SECOND SEMESTER

ME2C02 : MATHEMATICAL ECONOMICS

4 hours/week **3 credits** **30 weightage**

Text books:

1. M.L. Jhingan: Micro Economic Theory, 6th ed., Vrinda Publications.
2. Edward T. Dowling: Introduction to Mathematics, Economics, Second edition, Schaum's Outline, McGraw Hill.
3. Kothari : Quantitative Techniques, Third edition, Vikas Pub. House, Chapter 14.
4. Mehta-Madnani : Mathematics for Economists, Revised ed., S. Chand.

Module I : Inequalities in Income (10 hrs)

Inequalities in income, Causes of inequalities, Measures to reduce inequality; Measurement of inequality of income – Lorenz curve, Gini ratio.

(Chapter 47 of Text 1)

Module II : Linear Programming (22 hrs)

Mathematical Expression for Economic problems, Graphic solutions, The Extreme point theorem, Slack and surplus variables, Simpler Algorithm – Maximization – Minimization, Marginal values and Shadow pricing, The dual statement of dual theorems, Solving the primal through the dual.

(chapters 13, 14, 15 of text 2)

Module III : Game theory (20 hrs)

Meaning, characteristics, definition of various terms, two-person's zero sum game – pay off matrix, maxin strategy, minimax strategy, saddle point, mixed strategy, Dominance solution through graphic method – linear programming solution to two-persons zero sum game – limitation of game theory.

(chapter 14 of text 3)

Module IV : Input Output Analysis (20 hrs)

Introduction – assumptions – technological coefficient matrix – closed and open input output model – coefficient matrix and open model – The Hawkins – Simon conditions – Solutions for two industries – Determination of equilibrium of prices – Coefficient matrix and closed model – The Leontief production function – limitation of input-output analysis.

(chapter 19 – sections 19.1 to 19.7, 19.9, 19.11, 19.13).

References

1. A.C. Chiang & K. Wainwright : Fundamentals of Mathematical Economics, 4th ed., McGraw Hill.

2. R.G.D. Allen : Mathematical Economics, ELBS.

3. Taro Yamane: Mathematics for Economits, 2nd ed., PHI.

4. P.K. Gupta & ManMohan : Linear Programming and Theory of Games.

5. Srinath Baruah : Basic Mathematics and its Applications in Economics, Macmillan.

6. Akinson : Distribution and Inequality Measures, TMH.

B.Sc. DEGREE PROGRAMME

MATHEMATICAL ECONOMICS (COMPLEMENTARY COURSE)

THIRD SEMESTER

ME3C03 : MATHEMATICAL ECONOMICS

5 hours/week **3 credits** **30 weightage**

Text book:

1. Edward T. Dowling : Introduction to Mathematical Economics, Third edition, TMH.
2. S.P. Singh, A.K. Parashar & H.P. Singh : Econometrics and Mathematical Economics, S. Chand.
3. C.R. Kothari : An Introduction to Operations Research, Third edition, Vikas Publishing House.

Module I : Differential and Difference Equations (25 hrs)

Differential equations: Definitions and concepts. First order linear differential equations. Exact differential equations – integrating factors. Separation of variables. Economic applications – Use of differential equations in economics. Difference equations: definitions and concepts. First order linear difference equations. Economic applications – the Cobweb model, the Harrod model.

(Chapters 16 and 17 of Text 1)

Module II : The Production function (20 hrs)

Meaning and nature of production functions. The law of variable proportions – isoquants marginal rate of technical substitution (MRTs). Producer's equilibrium. Expression path. The elasticity of substitution. Ridge lines and economic region of production.

(Chapter 14 Section 14.1 to 14.9 of Text 2)

Module III : (20 hrs)

Euler's Theorem (Statement only). Euler's Theorem and Homogeneous production function. Cobb Douglas Production function. Properties. Economic significance – Limitations. CES production function – Properties – Advantages – Limitations – Returns to scale – Cobweb Theorem.

(Chapter 14, Section 14.10 to 14.13 of Text 2).

Optimization of Cobb Douglas production functions – Optimization of constant elasticity of production function.

(Chapter 6; Sections 6.9 and 6.10 of Text 1).

Module IV : Investment Decisions and Analysis of Risk (25 hrs)

Nature of investment decisions; Appraisal necessary; Needed information; Appraisal techniques; Payback method; Average Rate of Return (ARR) method;

Net Present Value (NPV) Method; Internal Rate of Return (IRR) Method; Net Terminal Value Method; Profitability Index (P.I); Analysis of Risk / Uncertainty; The Risk Concept; Risk and Uncertainty Situations; Measurement of Risk in Precise Terms; Incorporating Risk in Investment decisions; Risk-adjusted discount rate (RAD) approach; Certainty-Equivalent Approach; Probability Distribution Approach (The Hillier Models); Decision Trees Approach; Simulation Approach (Hertz's Model); Sensitivity Analysis.

(Chapter 16 of Text 3).

References

1. A.C. Chiang & K. Wainwright : Fundamentals of Mathematical Economics, 4^{th} ed., McGraw Hill.
2. Taro Yamane: Mathematics for Economics, 2^{nd} ed., PHI.
3. Srinath Baruah : Basic Mathematics and its Applications in Economics, Macmillan.

B.Sc. DEGREE PROGRAMME

MATHEMATICAL ECONOMICS (COMPLEMENTARY COURSE)

FOURTH SEMESTER

ME4C04 : MATHEMATICAL ECONOMICS

5 hours/week **3 credits** **30 weightage**

Text book: Damodar N. Gujarati & Sangeetha : Basic Econometrics, 4th ed., TMH Indian Reprint, 2008.

Module I (20 hrs)

Introduction to Econometrics – The nature of regression analysis – Two variable regression analysis (pages 1 to 59 of the text).

Module II (25 hrs)

Two variable regression model (Section 3.1 to 3.9 of the text pages 60-103).

Module III (25 hrs)

Classical normal linear regression model – two variable regression – Internal Estimation and Hypothesis testing (Sections 4.1 to 4.5 and 5.1 to 5.13 of the text).

Module IV (20 hrs)

Extensions of the two variable linear regression model (Sections 6.1 to 6.10 of the text).

References

1. S.P. Singh, A.K. Parashar and H.P. Singh : Econometrics and Mathematical Economics, S. Chand.

PATTERN OF QUESTION PAPER

For each course the external examination is of 3 hours duration and has maximum weightage 30. The question paper has 4 parts. Part I is compulsory which contains 12 objective type / fill in the blanks multiple choice type questions set into 3 bunches of four questions. Each bunch has weightage 1. Part II is compulsory and contains 9 short answer type questions and each has weightage 1. Part III has 7 short essay type/paragraph questions of which 5 are to be answered and each has a weightage 2. Part IV contains three essay type questions of which 2 are to be answered and each has weightage 4.

Part	No. of Questions	No. of questions to be answered	Weightage
I (Objective type)	3 bunches of 4 questions	All	3x1 = 3
II (Short Answer)	9	All	9x1 = 9
III (Short Essay)	7	5	5x2 = 10
IV (Long Essay)	3	2	2x4 = 8