# PERIYAR UNIVERSITY

## PERIYAR PALKALAI NAGAR

## SALEM – 636 011

### DEGREE OF BACHELOR OF SCIENCE

*CHOICE BASED CREDIT SYSTEM*

*Syllabus for*

# B.SC., MATHEMATICS

**(SEMESTER PATTERN)**

**(For Candidates admitted in the Colleges affiliated to Periyar University from 2021-2022 onwards)**

# PERIYAR UNIVERSITY, SALEM – 636 011

## B.Sc., MATHEMATICS / B.Sc., MATHEMATICS (CA)

## BOARD OF STUDIES MEMBERS 2021 – 2022

| | | |
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| 1. | Tmt. V. Emimal Navajothi<br>Associate Professor, Department of Mathematics ,<br>N. K. R. Government Arts College for Women,<br>Namakkal – 637 001. Ph:9442436670<br>E-mail:nkrgacin@rediffmail.com | Chairman |
| 2. | Tmt. G. Vasuki<br>Associate Professor, Department of Mathematics ,<br>Sri Sarada College for Women(Autonomous),<br>Fairlands, Salem – 636 016. Ph:9486482770 | Member |
| 3. | Thiru. G. Sivaram<br>Associate Professor, Department of Mathematics,<br>Government Arts College(Autonomous),<br>Salem – 636 007. Ph:9443933465 | Member |
| 4 | Ms. M. Sujatha<br>Assistant Professor, Department of Mathematics,<br>K. S. Rangasamy College of Arts & Science,<br>Tiruchengode – 637 215. Namakkal (Dt).<br>Ph: 9345166407. | Member |
| 5 | Dr. V. Sadhasivam<br>Associate Professor, Department of Mathematics,<br>Thiruvalluvar Government Arts College, Andagallur Post,<br>Rasipuram – 637 401. Namakkal(Dt).<br>Ph:9843554565 | Member |
| 6. | Thiru. R. Kodeeswaran<br>Associate Professor, Department of Mathematics,<br>Kandaswami Kandar's College, Paramathy Velur,<br>Namakkal – 638 182. Ph:9442173425 | Member |
| 7. | Thiru. K. Thiagu<br>Assistant Professor, Department of Mathematics,<br>Kandaswami Kandar's College, Paramathy Velur,<br>Namakkal – 638 182. | Invitee |
| 8. | Dr. A. Muthusamy,<br>Professor, Department of Mathematics,<br>Periyar University, Salem -636 011. | University Nominee |

| | | |
|---|---|---|
| | Ph:9842035190 | |
| 9. | Dr. D. Gunasekaran<br>Associate Professor, Department of Mathematics,<br>P.S.G College of Arts & Science, Avinashi Road, Civil Aerodrome(Road), Coimbatore – 641 014.<br>Ph:9790502357 | External Member |
| 10. | Dr. R. Parvathi<br>Associate Professor & Head,<br>Department of Mathematics,<br>Vellalar College for Women(Autonomous),<br>Erode – 638 012. Ph:9487323070 | External Member |
| 11. | Mr. Ajiith Paul, R@D Engineer SW<br>Broadcom Communication Technologies Pvt. LTD, S1,<br>Wibro Electronic City Special Economic Zone,<br>Doddathogur Village, Begur Hobli, Electronic City ,<br>Bangalore – 560 100. | Industrial Personal |
| 12. | Dr. R. Samidurai<br>Assistant Professor, Department of Mathematics,<br>Thiruvalluvar University, Serkkadu,<br>Vellore – 632115, Mobile: 9444876735. | Alumni |

# OBJECTIVES

Mathematics is a key to success in the field of science and engineering. Mathematics plays an important role in the context of globalization of Indian economy, modern technology, and computer science and information technology. Today, students need a thorough knowledge of basic principles, methods, results and a clear perception of the power of mathematical ideas and tools to use them effectively in modeling, interpreting and solving the real world problems. The syllabus of this program is aimed at preparing the students with the latest developments and put them on the right track to fulfill the present requirements.

## COMMENCEMENT OF THIS REGULATION

This regulation shall take effect from the academic year 2021 – 2022, i.e, for the students who are admitted to the first year of the course during the academic year 2021 – 2022 and thereafter.

## ELIGIBILITY FOR ADMISSION

A Pass in the Higher Secondary Examination of Tamil Nadu Higher Secondary Board or some other Board accepted by the Syndicate as equivalent thereto with Mathematics (other than Business mathematics) as one of the subjects.

## DEFINITIONS

**Programme:** Program means a course of study leading to the award of the degree in a discipline.

**Course:** Course refers to the subject offered under the degree programme.

## SYLLABUS

The syllabus of the UG degree has been divided into the following five categories:

| | | |
|---|---|---|
| Part I | : | Tamil / Other Languages. |
| Part II | : | English Language. |
| Part III | : | Core Courses, Elective Courses and Allied Courses. |
| Part IV | : | Skill Based Elective Courses, Non-Major Course, Environmental Studies and Value Education. |
| Part V | : | Extension Activity. |

- **Elective Course:** There are 2 Elective Courses offered for B.Sc. Mathematics students. One course from each set should be selected for each elective course.
- **Skill Based Elective Course:** This course aims to impart advanced and recent developments in the concerned discipline.
- **Non-Major Course:** Irrespective of the discipline the student can select papers that are offered by other disciplines as non-major course.
- **Extension Activity:** Participation in NSS / NCC / YRC / RRC / Sports or other co-circular activities are considered for Extension activity.

## CREDITS

Weightage given to each course of study is termed as credit.

## CREDIT SYSTEM

The weightage of credits are spread over to different semester during the period of study and the cumulative credit point average shall be awarded based on the credits earned by the students. A total of 148 credits are prescribed for the under graduate programme.

## DURATION OF THE COURSE

The candidates shall complete all the courses of the programme within 5 years from the date of admission. The programme of study shall consist of six semesters and a total period of three years with 148 credits. The programme of study will comprise the course according to the syllabus.

## EXAMINATIONS

The course of study shall be based on semester pattern with Internal Assessment under Choice Based Credit System.

The examinations for all the papers consist of both Internal (Continuous Internal Assessment-CIA) and External (end semester) theory examination. The theory examination shall be conducted for three hours duration at the end of each semester. The candidates failing in any subjects(s) will be permitted to appear for the same in the subsequent semester examinations.

## PROGRAMME OUTCOME

| | |
|---|---|
| PO1 | Good foundation in fundamentals of Mathematics subjects will be acquired. |
| PO2 | Knowledge and skills to undertake further studies in Mathematics and its allied areas will be ensured |
| PO3 | Scientific temper, analytical thinking, imagination, creativity and critical thinking will be developed. |
| PO4 | Knowledge and confidence to face various competitive examinations will be gained. |

# COURSE OF STUDY AND SCHEME OF EXAMINATION

| PART | Paper Code | SUBJECT TITLE | HOURS | | | Credit | Exam Hours | MARKS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Lecture | Practical | Total | | | CIA | EA | Total |
| **SEMESTER – I** | | | | | | | | | | |
| I | Language | Tamil –I | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |
| II | Language | English – I | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |
| III | 21UMA01 / 21UMACA01 | Core I – Classical Algebra | 4 | - | 4 | 4 | 3 | 25 | 75 | 100 |
| III | 21UMA02 / 21UMACA02 | Core II – Calculus | 5 | - | 5 | 5 | 3 | 25 | 75 | 100 |
| III | Allied – I | | 5 | - | 5 | 4 | 3 | 25 | 75 | 100 |
| III | Allied – I | Practical | - | 2 | 2 | - | * | - | - | - |
| IV | 20UPES01 | Professional English for Physical Sciences – I | 6 | - | 6 | 4 | 3 | 25 | 75 | 100 |
| IV | Value Education | Yoga | 2 | - | 2 | - | 3 | 25 | 75 | 100 |
| **SEMESTER – II** | | | | | | | | | | |
| I | Language | Tamil- II | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |
| II | Language | English – II | 4 | - | 4 | 3 | 3 | 25 | 75 | 100 |
| III | 21UMA03 / 21UMACA03 | Core III – Analytical Geometry of 2D & 3D | 4 | - | 4 | 4 | 3 | 25 | 75 | 100 |
| III | 21UMA04 / 21UMACA04 | Core IV – Trigonometry and Vector Analysis | 5 | - | 5 | 5 | 3 | 25 | 75 | 100 |
| III | | Naan Mudhalvan SDC - Language Proficiency for Employability | 2 | - | 2 | 2 | 3 | 25 | 75 | 100 |
| III | Allied – II | | 5 | - | 5 | 3 | 3 | 25 | 75 | 100 |
| III | Allied – II | Practical | - | 2 | 2 | 3 | 3 | 40 | 60 | 100 |
| IV | 20UPES02 | Professional English for Physical Sciences – II | 6 | - | 6 | 4 | 3 | 25 | 75 | 100 |
| IV | EVS | Environmental Studies | 2 | - | 2 | - | 3 | 25 | 75 | 100 |
| **SEMESTER – III** | | | | | | | | | | |
| I | Language | Tamil – III | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| II | Language | English – III | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |
| III | 21UMA05 / 21UMACA05 | Core V – Number Theory | 3 | - | 3 | 3 | 3 | 25 | 75 | 100 |
| III | 21UMA06 / 21UMACA06 | Core VI – Differential Equations | 3 | - | 3 | 3 | 3 | 25 | 75 | 100 |
| III | Allied – II | Paper – I | 5 | - | 5 | 4 | 3 | 25 | 75 | 100 |
| III | Allied - Practical - II | Paper - III (Practical) | | 2 | 2 | - | ** | - | - | - |
| IV | 21UMAS01 | SBEC I – Financial Mathematics | 3 | - | 3 | 3 | 3 | 25 | 75 | 100 |
| IV | NMEC- I | | 2 | - | 2 | 2 | 3 | 25 | 75 | 100 |
| **SEMESTER – IV** | | | | | | | | | | |
| I | Language | Tamil – IV | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |
| II | Language | English – IV | 6 | - | 6 | 3 | 3 | 25 | 75 | 100 |
| III | 21UMA07 | Core VII – Laplace Transforms & Fourier Series | 4 | - | 4 | 4 | 3 | 25 | 75 | 100 |
| III | 21UMA08 | Core VIII – Numerical Methods | 3 | - | 3 | 3 | 3 | 25 | 75 | 100 |
| III | Allied – II | Paper – II | 5 | - | 5 | 3 | 3 | 25 | 75 | 100 |
| III | Allied -II | Paper - III (Practical) | - | 2 | 2 | 3 | 3 | 40 | 60 | 100 |
| III | | Naan Mudhalvan SDC - Digital Skills for Employability | 2 | - | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | NMEC- II | | 2 | - | 2 | 2 | 3 | 25 | 75 | 100 |
| **SEMESTER – V** | | | | | | | | | | |
| III | 21UMA09 / 21UMACA09 | Core IX – Modern Algebra | 6 | - | 6 | 5 | 3 | 25 | 75 | 100 |
| III | 21UMA10 / 21UMACA10 | Core X – Real Analysis – I | 6 | - | 6 | 5 | 3 | 25 | 75 | 100 |
| III | 21UMA11 / 21UMACA11 | Core XI – Operations Research | 5 | - | 5 | 5 | 3 | 25 | 75 | 100 |
| III | 21UMA12 / 21UMACA12 | Core XII – Mechanics | 6 | - | 6 | 5 | 3 | 25 | 75 | 100 |
| III | Elective - I Group A | | 4 | - | 4 | 4 | 3 | 25 | 75 | 100 |
| IV | 21UMAS03 | SBEC III – C - Programming (Theory) | 3 | - | 3 | 3 | 3 | 25 | 75 | 100 |
| **SEMESTER – VI** | | | | | | | | | | |
| III | 21UMA13 / 21UMACA13 | Core XIII – Linear Algebra | 5 | - | 5 | 5 | 3 | 25 | 75 | 100 |
| III | 21UMA14 / 21UMACA14 | Core XIV – Real Analysis – II | 6 | - | 6 | 6 | 3 | 25 | 75 | 100 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| III | 21UMA15 / 21UMACA15 | Core XV – Complex Analysis | 5 | - | 5 | 5 | 3 | 25 | 75 | 100 |
| III | 21UMA16 / 21UMACA16 | Core XVI – Graph Theory | 5 | - | 5 | 5 | 3 | 25 | 75 | 100 |
| III | Elective - II Group B | | 4 | - | 4 | 4 | 3 | 25 | 75 | 100 |
| III | | Naan Mudhalvan SDC - Sales force Associates | 2 | - | 2 | 2 | 3 | 25 | 75 | 100 |
| IV | 21UMASP04 | SBEC IV – Office Automation (Practical ) | - | 3 | 3 | 3 | 3 | 40 | 60 | 100 |
| | | Extension Activity | - | - | - | 1 | *** | - | - | *** |

\# - Syllabus and Question paper are same for Bsc., Maths & Bsc., Maths (CA). The exam should be conducted on the same day

* - Examination at the end of Second Semester.

** - Examination at the end of Fourth Semester.

*** - No Examination – Participation in NCC / NSS / RRC / YRC / Others if any.

## ALLIED SUBJECTS FOR B.Sc. MATHEMATICS:

Any two of the following subjects (Physics / Chemistry / Statistics) can be chosen as Allied Subjects.

| NAME OF THE COURSE | PAPER CODE |
|---|---|
| Allied Physics – I | |
| Allied Physics – II | |
| Allied Physics – Practical | |
| Allied Chemistry – I | |
| Allied Chemistry – II | |
| Allied Chemistry – Practical | |
| Allied Statistics – I | |
| Allied Statistics – II | |
| Allied Statistics – Practical | |

# ELECTIVE COURSES:

Select one paper from Group – A for Elective Course-I and one paper from Group – B for Elective Course II.

**TABLE 1**

| NAME OF THE COURSE | PAPER CODE |
|---|---|
| **Group A:** | |
| Discrete Mathematics | 21UMAE01 |
| Astronomy | 21UMAE02 |
| Java Programming | 21UMAE03 |
| **Group B:** | |
| Fuzzy Sets and Fuzzy Logic | 21UMAE04 |
| Formal Languages and Automata Theory | 21UMAE05 |
| C++ Programming | 21UMAE06 |

# SKILL BASED ELECTIVE COURSE:

| NAME OF THE COURSE | PAPER CODE |
|---|---|
| Financial Mathematics | 21UMAS01 |
| C Programming (Theory) | 21UMAS02 |
| Office Automation (Practical) | 21UMASP03 |

# ALLIED MATHEMATICS

| NAME OF THE COURSE | PAPER CODE |
|---|---|
| Paper I: Allied Mathematics – I | 21UMAA01 |
| Paper II: Allied Mathematics – II | 21UMAA02 |
| Paper III: Allied Mathematics – Practical | 21UMAAP01 |

# NON – MAJOR ELECTIVE COURSES:

| **Non – Major Elective Course – I**<br>**III Semester** | **PAPER CODE** |
|---|---|
| Quantitative Aptitude – I | 21UMAN01 |
| Linear Programming | 21UMAN02 |
| **Non – Major Elective Course – II**<br>**IV Semester** | |
| Quantitative Aptitude – II | 21UMAN03 |
| Numerical Methods | 21UMAN04 |

**UNIFORMITY IN THE NUMBER OF UNITS IN EACH PAPER:**

Each theory paper shall consist of five units. The Question paper shall consist of questions uniformly distributed among all the units.

**1. QUESTION PAPER PATTERN FOR THE THEORY PAPERS**

Duration: **Three Hours** Maximum Marks: **75**

**Part A: (15 X 1 = 15 marks)**

Answer ALL Questions

(Three Questions from Each Unit)

**Part B: (2 X 5 = 10 marks)**

Answer Any Two Questions

(One Question from Each Unit)

**Part C: (5 X 10 = 50 marks)**

Answer ALL Questions

(One Question from Each Unit with internal choice)

**2. MARKS AND QUESTION PAPER PATTERN FOR PRACTICALS**

MAXIMUM: **100 Marks** INTERNAL MARK: **40 marks**

EXTERNAL MARK: **60 marks**

(Practical Exam -45 marks + Record - 15 marks)

**QUESTION PATTERN FOR THE PRACTICAL EXAM PAPERS**

Answer any THREE questions out of 5 questions (3 x 15 = 45 marks)

**PASSING MINIMUM**

i) The Candidates shall be **declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Theory Exam mark) with minimum of 30 marks in the Theory Exam conducted by the University.**

ii) The Candidates shall be **declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Practical Exam mark) with minimum of 18 marks out of 45 marks in the Practical Exam conducted by the University.**

**CONVERSION OF MARKS TO GRADE POINTS AND LETTER GRADE (Performance in a Programme/Paper)**

| RANGE OF MARKS | GRADE POINTS | LETTER GRADE | DESCRIPTION |
|---|---|---|---|
| 90-100 | 9.0-10. | O | Outstanding |
| 80-89 | 8.0-8. | D+ | Excellent |
| 75-79 | 7.5-7.9 | D | Distinction |
| 70-74 | 7.0-7.4 | A+ | Very Good |
| 60-69 | 6.0-6.9 | A | Good |
| 50-59 | 5.0-5.9 | B | Average |
| 40-49 | 4.0-4.9 | C | Satisfactory |
| 00-39 | 0.0 | U | Re-appear |
| ABSENT | 0.0 | AAA | ABSENT |

C**i** = Credits earned for course i in any semester
Gi = Grade Point obtained for course i in any semester
n = refers to the semester in which such course were credited

# Grade point average (for a Semester):

**Calculation of grade point average semester-wise and part-wise is as follows:**

GRADE POINT AVERAGE [GPA] = **Σ**i Ci Gi / **Σ**i Ci

Sum of the multiplication of grade points by the credits of the courses offered under each part GPA= .....
Sum of the credits of the courses under each part in a semester

**Calculation of Grade Point Average (CGPA) (for the entire programme):**

A candidate who has passed all the examinations under different parts (Part-I to V) is eligible for the following part wise computed final grades based on the range of CGPA.

**CUMULATIVE GRADE POINT AVERAGE [CGPA] = ΣnΣi Cni Gni / Σn Σi Cni**

Sum of the multiplication of grade points by the credits of the entire programme under each part CGPA=

.....
Sum of the credits of the courses of the entire programme under each part

| CGPA | GRADE |
|---|---|
| 9.5 – 10.0 | **O+** |
| 9.0 and above but below 9.5 | **O** |
| 8.5 and above but below 9.0 | **D++** |
| 8.0 and above but below 8.5 | **D+** |
| 7.5 and above but below 8.0 | **D** |
| 7.0 and above but below 7.5 | **A++** |
| 6.5 and above but below 7.0 | **A+** |
| 6.0 and above but below 6.5 | **A** |
| 5.5 and above but below 6.0 | **B+** |
| 5.0 and above but below 5.5 | **B** |
| 4.5 and above but below 5.0 | **C+** |
| 4.0 and above but below 4. | 5**C** |
| 0.0 and above but below 4.0 | **U** |

**Classification of Successful candidates**

A candidate who passes all the examinations in Part I to Part V securing following CGPA and Grades shall be declared as follows **for Part I or Part II or Part III**:

| CGPA | GRADE | |
|---|---|---|
| 9.5 – 10.0 | **O+** | First Class – Exemplary * |
| 9.0 and above but below 9.5 | **O** | First Class with Distinction* |
| 8.5 and above but below 9.0 | **D++** | First Class |
| 8.0 and above but below 8.5 | **D+** | |
| 7.5 and above but below 8.0 | **D** | |
| 7.0 and above but below 7.5 | **A++** | |
| 6.5 and above but below 7.0 | **A+** | |
| 6.0 and above but below 6.5 | **A** | |
| 5.5 and above but below 6.0 | **B+** | Second Class |
| 5.0 and above but below 5.5 | **B** | |
| 4.5 and above but below 5.0 | **C+** | |

**Conferment of the Degree**

No candidate shall be eligible for conferment of the Degree unless he / she

i. has undergone the prescribed course of study for a period of not less than six semesters in an institution approved by/affiliated to the University or has been exempted from in the manner prescribed and has passed the examinations as have been prescribed therefor.

ii. Has completed all the components prescribed under Parts I to Part V in the CBCS pattern to earn 140 credits.

iii. Has successfully completed the prescribed Field Work/ Institutional Training as evidenced by certificate issued by the Principal of the College.

**Ranking**

A candidate who qualifies for the UG degree course passing all the examinations in the first attempt, within the minimum period prescribed for the course of study from the date of admission to the course and secures I or II class shall be eligible for ranking and such ranking shall be confined to 10 % of the total number of candidates qualified in that particular branch of study, subject to a maximum of 10 ranks. The improved marks shall not be taken into consideration for ranking.

**NOTE:**

- All the Papers (including computer papers) specified in this syllabus should be handled and valued by faculty of Mathematics Department only.
- Both Internal and External Examiners for University Practical Examination should be appointed (including computer papers) from faculty of Mathematics only.

# B.Sc., MATHEMATICS

## SEMESTER I

## CORE I - CLASSICAL ALGEBRA

**Paper Code: 21UMA01 / 21UMACA01** **Max. Marks: 75**

**COURSE OBJECTIVE**

The course aims to

1. Gain knowledge about binomial series, exponential series, logarithmic series and matrices.
2. Develop the ability of solving different types of algebraic equations.
3. Develop the ability to reflect critically on the methods they have chosen to solve problems.

**UNIT – I**

Binomial series: Binomial theorem for a positive integral index – Binomial theorem for a rational index –Summation of Binomial series. Exponential Series: Exponential series for all real values of x – Standard results for the exponential series – Logarithmic series.

Chapter 2(Section 1, 2, 3), Chapter 3 (Section 1 & 2) & Chapter 4

**UNIT – II**

Matrices: Condition for consistency – Characteristic equation of a matrix – Cayley-Hamilton theorem – Similarity of matrices – Diagonalizable matrix.

Chapter 6

**UNIT – III**

Theory of equations: Rational integral equation of the $n^{th}$ degree, Fundamental theorem in the theory of equations (without proof) – Relation between the roots and coefficients of an equation – Imaginary and Irrational roots – Symmetric functions of the roots of an equation in terms of its coefficients.

Chapter 7 (Sections 1 to 5)

**UNIT – IV**

Reciprocal equations – Transformation of equation – Multiplication of roots by m – Diminishing the roots of an equation – Removal of a term.

Chapter 7 (Section 6 to 10)

**UNIT – V**

Descarte's rule of signs – Descarte's rule of signs for negative roots of an equation – Horner's method for approximation of roots of a polynomial equation – Newton's method of evaluating a real root correct to given decimal places.

Chapter 7 (Section 11 to 14)

**TEXT BOOK:**

1. Algebra, Analytical Geometry & Trigonometry by Dr.P.R.Vittal & Malini, Margham Publications, Chennai – 17.

**REFERENCE BOOKS:**

1. Algebra Volume I by T.K. Manickavasagam Pillai & others, S.V. Publications, 1985.
2. Algebra Volume II by T.K. Manickavasagam Pillai & others, S.V. Publications, 1985.

**COURSE OUTCOME**

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

| | |
|---|---|
| CO 1 | Gain knowledge about binomial, exponential and logarithmic series |
| CO 2 | Examine the consistency of linear equations and application of Cayley-Hamilton theorem |
| CO 3 | Know the application of relations between the roots and coefficients of an equation |
| CO 4 | Analyse the method of solving reciprocal equations and diminishing the roots of an equation |
| CO 5 | Examine the existence of roots of an equation and determine the roots by using Newton's and Horner's methods |

## SEMESTER I

## CORE II – CALCULUS

**Paper Code: 21UMA02 / 21UMACA02** **Max. Marks: 75**

**COURSE OBJECTIVE**

To impart knowledge about curvatures, integrations and its geometrical applications. To enable the students to Differentiate and integrate any given functions, identify a special function and evaluate an Integral.

**UNIT I**

Curvature-radius of curvature in Cartesian and polar forms-evolutes and envelopes- pedal Equations, Chord of curvature.

Volume I: Chapter 10 (Section 2.1 - 2.7, 3.1)

**UNIT II**

Integration by parts, Reduction formulae, Bernoulli's formula, Integration as summation.Geometrical applications of integration: Areas under plane curves, Areas of a closed curve, Areas in polar coordinates.

Volume II: Chapter 1 (Section 12, 13.1-13.10, 15.1, 15. 2) &
Chapter 2 (Section 1.1, 1.2, 1.4)

**UNIT III**

Evaluation of double and triple integrals- applications to calculations of areas and volumes - areas in polar coordinates.

Volume II : Chapter 5 (Section 2.1, 2.2, 3.1, 3.2, 4,5.1, 6.3)

**UNIT IV**

Change of Variables – Jacobians – change of variables in double and triple integrals notion of improper integrals.

Volume II : Chapter 6 (Section 1.1, 1.2, 2.1-2.4)
Chapter 7 (Section 1.1- 1.5)

**UNIT V**

Beta and Gamma integrals - their properties, relation between them- evaluation of multiple integrals using Beta and Gamma functions.

Volume II: Chapter 7 (Section 2.1 - 2.3, 3, 4, 5)

**TEXT BOOK**

T.K. ManikavachagomPillay, S. Narayanan, **Calculus –Volume I and Volume II**

**REFERENCE BOOKS**

1 P. Kandasamy and K. Thilagavathy, 2004 – **Mathematics for B.Sc. –Vol. I and Vol. II**
S. Chand and Company 2004

2. Shanthy Narayanan and J.N. Kapoor – **A Text book of Calculus –** S. Chand and Company

**COURSE OUTCOME**

- Gain knowledge about curvature and envelopes.
- Gain knowledge about integration and its applications.

## SEMESTER II

## CORE III - ANALYTICAL GEOMETRY OF 2D & 3D

**Paper Code: 21UMA03 / 21UMACA03** **Max. Marks: 75**

**COURSE OBJECTIVE**

To enable the students to be familiar with the ideas of polar equations and enhance the knowledge of three-dimensional geometry.

**UNIT I**

Analytical Geometry of 2D: Polar Equations: Polar Co-ordinates – Polar equation of a conic - chord – tangent – normal – equation of the pair of tangents drawn from the point to the conic - problems.

Chapter IX: Section 1 - 15

**UNIT II**

The Straight line: Symmetrical form – The plane and the straight line – Coplanar lines – Shortest distance between two given lines – The equation of two skew lines in a simplified form – problems.

Chapter III: section 1 – 8.2

**UNIT III**

Sphere: Equation of the sphere – Plane Section of a sphere – equation of a circle on a sphere – equation of a sphere passing through a given circle – equation of the tangent plane to the sphere.

Chapter IV: Section 1 – 8

**UNIT IV**

Cone – Right circular cone – Intersection of a straight line and quadric cone – tangent plane and normal – condition for the plane to touch the quadric cone – Angle between the lines in which the plane cuts the cone.

Cylinder: The equation of the cylinder – equation of the right circular cylinder – enveloping cylinder.

Chapter V: Section 1 – 8.3

**UNIT V**

Central quadrics: Definition – The intersection of a line and a quadric – Tangents and tangent planes – condition for the plane to touch the conicoid.

Chapter V: Section 9 – 12

**TEXT BOOK:**

1. A Text Book of Analytical Geometry part I – 2D, T.K. Manicavachagam pillay and T. Natarajan, S.Viswanathan Pvt. Ltd. (Unit – I)
2. A Text Book of Analytical Geometry part II - 3D, T.K. Manicavachagam pillay and T. Natarajan, S.Viswanathan Pvt. Ltd. (Unit – II to Unit V)

**REFERENCE BOOK:**

1. Analytical Geometry of 2D & 3D by P.R.Vittal, Pearson publications.
2. Analytical Solid Geometry by Shanti Narayan & Dr. P.K. Mittal, 16th Edition, S. Chand and Company Limited.

**COURSE OUTCOME**

| | |
|---|---|
| CO1 | To gain knowledge about Conic 2D |
| CO2 | Understand the concepts of coplanar lines and skew lines and find the shortest distance between them |
| CO3 | To gain the knowledge about sphere and identify the characteristics of sphere |
| CO4 | Enhance the fundamental concepts of cone and cylinder |
| CO5 | To develop the concepts of coincoides. |

# SEMESTER II

## Core IV – TRIGONOMETRY & VECTOR ANALYSIS

**Paper Code: 21UMA04 / 21UMACA04** **Max. Marks: 75**

**COURSE OBJECTIVE**

The course aims to

1. Acquire knowledge about the expansions of $sinn\theta$, $cosn\theta$, $tann\theta$, $cos^n\theta$, $sin^n\theta$, $tan^n\theta$, Hyperbolic functions, Inverse hyperbolic functions and Logarithms of a complex quantities.
2. Understand the concepts of divergence, curl and integration of vector point functions.
3. Analyse the various integral theorems in Vector Analysis

**TRIGONOMETRY**

**UNIT – I**

Expansion of $\sin n\theta$, $\cos n\theta$, and $\tan n\theta$ Expansions for $cos^n\theta$, $sin^n\theta$ Expansions of $\sin\theta$ and $\cos\theta$ in ascending powers of $\theta$.

Chapter 14 (page no: 14.1 to 14.30)

**UNIT – II**

Hyperbolic functions and Logarithms of complex numbers.

Chapter 14 (page no: 14.31 to 14.75)

**VECTOR ANALYSIS**

**UNIT – III**

Gradient of a scalar point function and Divergence and curl of a vector point function.

Chapter II (section 2.1 to 2.7)

**UNIT – IV**

Integration of point functions: Line Integrals – Surface integrals and Volume integrals.

Chapter III (section 3.1 to 3.8)

**UNIT – V**

Integral theorems: Gauss divergence theorem – Green's theorem – Stokes theorem (statement only).

Chapter IV (section 4.1 to 4.8)

**TEXT BOOK:**

1. Dr P.R. Vittal (Allied Mathematics), Margham publications, Chennai (for unit I and II).
2. P. Duraipandian and Laxmi Duraipandian, Emerald publishers, Chennai (for Unit III, Unit IV and Unit V).

**REFERENCE BOOK:**

**1.** T.K. Manickavasagam Pillai & others, Vector Analysis, Vijay Nicole Imprints Pvt. Ltd., Chennai -29, 2004.

**COURSE OUTCOME**

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

| | |
|---|---|
| CO 1 | Recall the basic concepts and understand the expansions of Trigonometric functions |
| CO 2 | Acquire knowledge on Hyperbolic functions and Logarithm of complex numbers |
| CO 3 | Gain knowledge on the concept of divergence, curl and integration of vector point functions |
| CO 4 | Analyse and work with the problems related to line integrals, surface and volume integrals |
| CO 5 | Solve the problems related to Gauss Stoke's and Green's theorems |

## SEMESTER III
## CORE V: NUMBER THEORY

**Paper Code: 21UMA05 / 21UMACA05** **Max. Marks: 75**

**COURSE OBJECTIVE**

On Completion of this course, the students are expected to know

- The concept of prime, composite, Fibonacci and Lucas numbers.
- The Euclidean algorithm, g.c.d, and l.c.m.
- To understand the method to solve linear Diophantine equations.
- To understand the method to apply Polland Rho Factoring method.
- The concept of Wilson's theorem, Fermates theorem, Euler's theorem.
- The concept of Continued Fractions.

**UNIT – I**

The Divisibility algorithm-Prime and Composite numbers-Fibonacci and Lucas numbers-Fermat numbers.

Section(2.1,2.5-2.7)

**UNIT – II**

Greatest Common Divisor-The Euclidean algorithm-Fundamental theorem of arithmetic-Least Common Multiple-Linear Diophantine Equations.

Section(3.1-3.5)

**UNIT - III**

Congruences-Linear Congruences-The Polland Rho Factoring method.

Section( 4.1-4.3)

**UNIT - IV**

Wilson theorem-Fermat's Little theorem-Psuedoprimes(optional)-Euler's theorem.

Section(7.1-7.4)

**UNIT - V**

Finite Continued Fractions-Infinite Continued Fractions-Pythagorean Triangles.

Section(12.1,12.2,13.1)

## TEXT BOOK:

1. Elementary number theory with applications – Thomas Koshy, Academic Press, 2007

## REFERENCE BOOKS:

1. Elementary Number Theory, D.M. Burton, Universal book stall, New Delhi, 2001.
2. Introduction to the theory of number, Ivan Niven, H.S. Zuckerman, Wiley Easter New Delhi, 3rd edition, 1989.
3. A Classical Introduction to Modern Number Theory, K. Ireland & M. Rosen, Springer Verlang Newyork, 1972/

**COURSE OUTCOME**

After completing the course the students will be able to

- To understand the basic properties of integers.
- Formally understand and prove various theorems.
- Applying theoretical results acquired to solve different problems.

## SEMESTER III
## Core -VI DIFFERENTIAL EQUATIONS

**Paper Code: 21UMA06 / 21UMACA06** **Max. Marks: 75**

**COURSE OBJECTIVE**

- To learn about formation differential equations, first order and first-degree differential equations.
- To learn the second order differential equation with constant coefficient and variable coefficients.
- To learn the partial differential equations, solution of equations standard types.

### UNIT – I

Ordinary Differential Equations: Formation of Differential Equations- Equations of the First Order and ofthe First degree- Equations of the First Order, but of higher degree.

### UNIT - II

Second Order Differential Equations with Constant Co-efficient- Particular Integrals of the form 'V', where V is of the form, X, $X^2$, sin ax, cos ax, X sin ax and X cos ax.

### UNIT – III

Second Order Differential Equations with Variable Co-efficient- Bothhomogeneous linear equations and homogeneous non-linear equations- Total Differential Equations.

### UNIT – IV

Partial Differential Equations: Definition- Formation of Partial differential equations- Completesolution- Singular solution- General Solution.

### UNIT – V

Solution of equation of Standard types $f(p,q)=0$, $f(X,p,q)=0$, $f(Y,p,q)=0$, $f(Z,p,q)=0$, $f_1(x,p)=f_2(y,q)$ Clairaut's form- Lagrange's equation $Pp+Qq=R$.

### TEXT BOOK:


1. S.Narayanan and T.K. Manickavachagam Pillay.

2. Differential Equations, Fourier and Laplace Transforms, Probability,by P.R. Vittal.


### REFERENCE BOOKS:


1. T.K. Manikavasagam Pillai and S.Narayanan, Calculus, Vijay NicoleImprints pvt, Ltd. Nelson Chambers, 115 Nelson Manickan Road, Chennai- 600029,2004.

2.Engineering Mathematics by M.K. Venkatraman, National PublishingCompany, Chennai.

**COURSE OUTCOME**

- Students will be able to classify the differential equations with respect to order and linearity.
- Students will be able to solve the second order differential equations, linear equations, linear differential equations with constant coefficients.
- Students will be able to understand the basic properties of standard PDE's and solve the problem in Clairaut's form.

# SEMESTER III
# SBEC I – FINANCIAL MATHEMATICS

## Paper Code: 21UMAS01 / 21UMACAS01 Max. Marks: 75

**COURSE OBJECTIVE**

In this course, the students are on posed to

- The basic concepts of Probability theory, The Central limit theorem.
- The concepts of Geometric Brownian motion, Option pricing.
- The derivatives of Blackschole formula and its applications.
- The concept of call option on Dividend paying securities, estimating the volatility parameter.
- The limitations of Arbitrage pricing, the portfolio selection problem.

**UNIT-I**

Probabilities and Events-Conditional Probability- -Random Variables and Expected Values-Covariance and Correlation-Continuous Random Variables-Normal Random Variables – Properties of Normal Random Variables- The Central Limit Theorem-Simple Problems.
Section (1.1 - 1.4, 2.1 - 2.4)

**UNIT-II**

Geometric Brownian Motion-Geometric Brownian Motion as a limit of Simple Models-Brownian Motion-Simple Problems- Interest Rates – Present Value Analysis- Rate of Return-Continuously Varying Interest Rates-An example of option Pricing –Other example of Pricing via Arbitrage.
Section (3.1 - 3.3, 4.1 - 4.4, 5.1, 5.2)

**UNIT-III**

The Arbitrage Theorem-The Multi period Binomial Model-Proof of the Arbitrage Theorem-The Black Scholes Formula-Properties of the Black –Sholes Option Cost-Derivation of Black Scholes Formula- Simple Problems.
Section (6.1 - 6.3, 7.2, 7.3, 7.5)

**UNIT-IV**

Additional results on options- Call option on Divided Paying Securities-Pricing American Put Options-Adding Jumps to Geometric Brownian Motion-Estimating the Volatility Parameter-Simple Problems.
Section (8.2 - 8.5)

**UNIT-V**

Valuing by Expected Utility-Limitation of Arbitrage pricing-Valuing Investments by Expected Utility-The portfolio selection problem—Value at risk and conditional value at risk The capital assets pricing model-Mean Variances analysis of risk-Neutral priced Call options-Rates of return-Single Period and Geometric Brownian Motion-- Simple Problems.
Section (9.1 - 9.7)

## TEXT BOOK:

| S.No | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | An Elementary Introduction to Mathematical Finance,2nd Edition | Sheldon M.Ross | Cambridge University press | 2005 |

## REFERENCE BOOKS:

| S.No | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | A First Course in Probability | S.M.Ross | Englewood cliffs Prentice Hall-NJ | 2002 |
| 2. | Option Market | J.Cox M.Rubinstein | Englewood cliffs Prentice Hall-NJ | 1985 |
| 3. | Theory of Financial decision Making | J.E.Ingersill | Lanjarn MD Rowerman of Little Fields | 1987 |

**COURSE OUTCOME**

After completing the course the students will be able to

- To understand the basic concepts of Financial Mathematics.
- To understand and prove theorems.
- To understand the method to solve the problems by applying principles and concepts of Financial Mathematics

# SEMESTER IV
# CORE VII: LAPLACE TRANSFORMS & FOURIER SERIES

## Paper Code: 21UMA07 / 21UMACA07 Max. Marks: 75

**COURSE OBJECTIVE**

The transforms such as Laplace Transform, Fourier Transform are widely used in the theory of communication engineering, wave propagation and other branches of applied Mathematics. Fourier series find its application with the study of vibration and heat diffusion.

**UNIT I: Laplace Transform**

Laplace transforms – Definition and properties– Elementary theorems with proof – Periodic function - Problems.
Chapter 7: Sections 1 to 3

**UNIT II: Inverse Laplace Transform**

Inverse Laplace transforms – Standard formulae – Elementary theorems problems – Applications to solving second order differential equations with constant coefficients - Application to solving first order simultaneous differential equations.
Chapter 7: Sections 4 & 5

**UNIT III: Fourier Series**

Fourier series – Definition – To find the Fourier coefficients of periodic functions of period $2\pi$ – Fourier Series for odd and even functions – Half range Fourier series – problems.(For the intervals 0 to $2\pi$ & $-\pi$ to $+\pi$)
Chapter: 6

**UNIT IV: Fourier Series**

Change of Interval $(0,2l)$ – Even and odd functions – Half range sine and cosine series - Simple problems.
Chapter 6: Sec. 6 & Sec. 7

**UNIT V: Fourier Transform**

Fourier integral theorem(Statement only) – Complex Fourier Transform and its inversions - Properties of Fourier transforms – Linearity property – Change of scale – Shifting property – Sine and cosine transforms - Properties - Simple problems.
Chapter: 8

**TEXT BOOK:**

1. P.R. Vittal, Differential Equations, Fourier and Laplace Transforms, Probability – Year of Publication 2000, Margham Publications, 24, Rameshwaram Road, T.Nagar, Chennai – 600 017. (Unit I, II, III & V)
2. T.K. Manickavasagampillai and S. Narayanan: Calculus (Vol III) – Year of Publication 2004.Vijay Nicole Imprints Pvt Ltd, # C-7 Nelson Chambers, 115, Nelson Manickam Road, Chennai – 600029(Unit IV)

**REFERENCE BOOKS:**

1. K. Shankar Rao: Introduction to partial differential equations – (Pp-278 to 291) – Year of Publication 1997. Prentice Hall India – New Delhi – 110001.

**COURSE OUTCOME**

After completion of these chapters the student are expected to

a. Have a sound knowledge of Laplace Transform and its properties.

b. Have sufficient exposure to get the solution of certain linear differential equation using Laplace Transform and inverse Laplace Transform.

c. Have an idea of periodic function and come to know how to expand the given functions as a series of sines and cosines which are simple periodic functions.

d. Have an idea of Fourier Transform and its properties which can be applied in future for solving Partial Differential equations by reducing the number of independent variable by one.

## SEMESTER IV

# CORE VIII: NUMERICAL METHODS

**Paper Code: 21UMA08 / 21UMACA08** **Max. Marks: 75**

**COURSE OBJECTIVE**

The aim of this course is to introduce numerical techniques that can be used on computer, rather than to provide a detailed treatment of accuracy or stability. The solution of some of the main problems of the scientific computing are introduced and their implementation and analysis are given by using interactive environments for computing and the scientific visualization.

**UNIT I: Solution of Algebraic & Transcendental equations**

The Bisection method – The Iteration method - The methodof False Position – Newton-Raphson method – Generalized Newton's method-Ramanujan's Method-Muller's method.

Chapter 2: Sections 2.1 to 2.7

**UNIT II: Interpolation with equal intervals**

Finite differences – Forward differences – Backward Differences – Central differences – symbolic relations and separation of symbols – Newton's formula for interpolation – central difference interpolation formula – Gauss's Central difference Formula – Stirling's formula – Bessel's formula – Everett's formula(Problems only).

Chapters 3: Section 3.3 (3.3.1 – 3.3.4), 3.6, 3.7 (3.7.1 -3.7.4)

**UNIT III: Interpolation with unequal intervals**

Lagrange interpolation formula -Divided differences – Divided difference table – Newton's divided difference formula – Inverse interpolation (Problems only).

Chapter 3: Sections 3.9.1,3.11.1,3.12

**UNIT IV: Numerical differentiation & Integration**

Numerical differentiation – Maximum and minimum values of a tabulated function – Numerical Integration – Trapezoidal rule – Simpson's 1/3 and 3/8 rule –Boole's and Weddle's rule(Problems only).

Chapter 5: Sections 5.2,5.3,5.4 (5.4.1-5.4.4)

**UNIT V: Solution of Simultaneous Linear Algebraic equations**

Direct method- Gauss Elimination – Gauss Jordan Method – Modification ofthe Gauss method to compute the inverse – Method of Factorization– iterative methods – Gauss Jacobi method – Gauss seidel method.

Chapter 6: Sections 6.3(6.3.2 – 6.3.4), 6.4

**TEXT BOOK:**

1. S.S. Sastry – Introductory methods of numerical Analysis 3rd edition, Prentice hall of India, Private Ltd, New Delhi.

**REFERENCE BOOKS:**

1. P.Kandasamy, K.Thilagavathy, K.Gunavathy, Numerical Methods, Third revised Edition, S.Chand & Company LTD, Ram Nagar, New Delhi.
2. T.Veerarajan, T.Ramachandran, Numerical Methods with programs in C and C++,

Tata Mc Graw – Hill Publishing Company Ltd., New Delhi.

3. E.Balagurusamy, Numerical methods, Tata Mecgraw Hill Publishing Company Limited, New Delhi-2002.

**COURSE OUTCOME**

Students who successfully complete the course will provide the following outcomes:

- Use numerical methods to solve the algebraic and transcendental equations by using Bisection, Newton's method and some iterative methods.
- Have a sufficient exposure in constructing difference tables and to use Newton's forward and backward formula for interpolation in equal intervals.
- Have learnt to construct divided difference table and to use Stirling's, Bessel's and Lagrange's interpolation formula for unequal intervals.
- Have understood the numerical differentiation and numerical differentiation and numerical integration by using Newton's methods and Trapezoidal, Simpson's rule.
- Have learnt the methods like matrix inversion, Gaussian, Gauss seidel methods etc., for solving linear system of algebraic equations.

## SEMESTER V

# CORE IX: MODERN ALGEBRA

## Paper Code: 21UMA09 / 21UMACA09 Max. Marks: 75

**COURSE OBJECTIVE**

1. Acquire knowledge about various groups.
2. Gain knowledge about Rings, Euclidean Rings and some special classes of Rings

**UNIT - I**

**Group theory -** Subgroups - A counting principle - Normal subgroups and Quotient groups.
Chapter 2 (sections 2.4, 2.5, and 2.6)

**UNIT - II**

**Group theory -** Homomorphisms – Automorphisms - Cayley's theorem and Permutation groups.
Chapter 2 (sections 2.7, 2.8, 2.9 and 2.10)

**UNIT – III**

**Ring theory -** Definition and examples of Rings - Some special classes of Rings - Homomorphisms - Ideals and Quotient Rings - More ideals and Quotient Rings.
Chapter 3 (sections 3.1, 3.2, 3.3, 3.4 and 3.5)

**UNIT – IV**

**Ring theory -** The field of Quotients of an Integral Domain - Euclidean Rings - A particular Euclidean Ring.
Chapter 3 (sections 3.6, 3.7 & 3.8)

**UNIT – V**

**Ring theory -** Polynomial Rings - Polynomials over the Rational field - Polynomial Rings over commutative Rings.
Chapter 3 (sections 3.9 to 3.11)

**TEXT BOOK:**

1. I.N. Herstein, Topics in Algebra, 2nd Edition, John wiley, New york, 1975.

**REFERENCE BOOKS:**

1. Dr. U.S. Rana, Mathematics for Degree students (B.Sc 3rd years), S.Chand 2012.
2. A.R. Vasishta, A first course in Modern Algebra, Krishna Prakasan Mandhir, 9 Shivaji road, Meerut(UP), 1983.
3. K. Viswanatha Naik, Emerald Publishers, 135 Anna salai, Chennai – 2, 1988 & 2001.

**COURSE OUTCOME**

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

| | |
|---|---|
| CO 1 | Understand the concepts of various Subgroups and its applications |
| CO 2 | Acquire Knowledge about the concepts of homomorphisms, isomorphisms and automorphisms |
| CO 3 | Gain knowledge about the concepts of Rings and Quotient Rings |
| CO 4 | Analyse the concept of Field and Euclidean Ring |
| CO 5 | Analyse and demonstrate the properties of Polynomial Rings |

# CORE X: REAL ANALYSIS - I

## Paper Code: 21UMA10 / 21UMACA10 Max. Marks: 75

**COURSE OBJECTIVE**

Upon Completion of this course, the students will be able to know

- The concepts of Countability, least upper bound axiom.
- The concept of Convergence of Sequence.
- Basic concepts of series and tests for absolute convergence of the series.
- The concept of metric spaces and examples.
- Basic principles of continuous functions on a metric space.

**UNIT – I**

Real valued function – Equivalence – Countability – Real numbers –Least upper bounds.Definitions of Sequence and Subsequence-Limit of a Sequence-Convergent Sequences-Divergent Sequences.

Section(1.4-1.7,2.1-2.4)

**UNIT – II**

Bounded Sequence-Monotone Sequences –Operations on Convergent Sequences-Limit Superior and Limit inferior-Cauchy Sequences.

Section(2.5- 2.10)

**UNIT – III**

Convergence and Divergence-Series with nonnegative terms-Alternating Series-Conditional Convergence and absolute Convergence-Tests for absolute Convergence.

Section(3.1-3.4,3.6)

**UNIT – IV**

Series whose terms form a non increasing sequences-Summation by Parts-The class $l^2$ - Limit of a function on a real line-Metric Spaces.

Section(3.7-3.10,4.1,4.2)

**UNIT – V**

Limits in Metric Spaces-Functions continuous at a point on the real line-Reformulation-Functions Continuous on a Metric Spaces-Open sets.

Section(4.3,5.1-5.4)

## TEXT BOOK:

| S.No | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Methods of Real Analysis | Richard R.Goldberg | IBM Publishing New Delhi. | 1970 |

**Reference Books**:

| S.No | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | A First Course in Real Analysis | Sterling K.Barberian | Springer(India) Private Limited ,New Delhi. | 2004 |
| 2. | Mathematical Analysis | Tom.M.Apostel | Narosa Publications,NewDelhi | 2002 |
| 3. | Real Analysis | M.S.Rangachari | New Century Book House,Chennai. | 1996 |

**COURSE OUTCOME**

After completing the course, the students are expected to know

- Understand basic concepts of sequence and series.
- Understand and prove various theorems.
- Understand the method to solve simple problems by applying concepts of Analysis.

## SEMESTER V

# CORE XI: OPERATIONS RESEARCH

**Paper Code: 21UMA11 / 21UMACA11** **Max. Marks: 75**

**COURSE OBJECTIVE**

The main objective of the course is to enable the students to apply Mathematics in everyday situations and develop model of decision making problems that involve constraints and linear programs.

**UNIT I: LINEAR PROGRAMMING PROBLEM**

Origin and development of O.R. – Characteristic features of O.R. - uses and limitations of O.R – Linear Programming problem – Mathematical Formulation - Graphical solution - General LPP- canonical and standard forms of LPP -– Simplexprocedure – computational procedure.

Chapter 1: Sections 1.1 to1.2, 1.9, Chapter 2: Sections 2.1 to 2.3, 2.5, 2.6 &
Chapter 3: Sections 3.1, 3.3

**UNIT II: LINEAR PROGRAMMING PROBLEM**

Artificial variable Techniques - surplus variables and artificial variable – Big 'M'method – Two phase method – Problems – concept of Duality – Formulation of primal – Dual pairs – Duality and simplex method – Dual simplex method – Dual simplex algorithm.

Chapter 3: Section 3.5 & Chapter 4: Sections 4.1 to 4.2, 4.5 to 4.7

**UNIT III: TRANSPORTATION AND ASSIGNMENT PROBLEM**

Transportation Problem-Introduction – Mathematical formulation of the transportation problem – Finding initial basic feasible solutions – Moving towards optimality – Degeneracy in a Transportation Problems - Unbalanced T.P. Assignment problem – Balanced and unbalanced A.P. – Hungarian method – Degeneracy in A.P.

Chapter 6: Sections 6.1 to 6.9 & Chapter 7: Sections 7.1 to 7.3

**UNIT IV GAMES AND STRATEGIES**

Introduction - Two person zero sum games-The Maximin-Minimax Principle - Games without saddle points- mixed strategies-Graphical solution of 2×n and m×2games-Dominance property

Chapter 9: Sections 9.1 to 9.7

**UNIT V SEQUENCING PROBLEMS**

Sequencing problems – Introduction – Basic assumptions – problem with n jobs and2 machines – problems with n jobs with 3 machines – n jobs to be operated on m machines – problems with two jobs on m machines (graphical method)

Chapter 10: Sections 10.1 to 10.5

**TEXT BOOK:**

1. Kanti Swarup, P.K. Gupta and Man Mohan, OPERATIONS RESEARCH, Eighth edition, Reprint 2000 – Sultan Chand & sons, New Delhi.

**REFERENCE BOOKS:**

1. S.Kalavathy – OPERATIONS RESEARCH – Second edition, year of publication 2002, Vikas publishing house, New Delhi,
2. P.K. Gupta and D.S.Hira - OPERATIONS RESEARCH year of publication2004 second edition , S.Chand and Co, New Delhi
3. Hamdy Taha - OPERATIONS RESEARCH year of publication 1996. PrenticeHall publications, New Delhi.

**COURSE OUTCOME**

On successful completion of this course students will be able to

- Formulate simple reasoning and learning optimization problems.
- Analyze a problem and can select a suitable strategy.
- Apply an appropriate method to obtain the solution to a problem.
- Manipulate the basic mathematical structures underlying these methods.
- Evaluate analytically the limitations of these methods.

## SEMESTER V
## CORE XII - MECHANICS

## Paper Code: 21UMA12 / 21UMACA12 Max. Marks: 75

**COURSE OBJECTIVE**

To enable the students to know about the concepts of types of forces, moments, friction, projectiles, impulsive forces and collision of elastic bodies and simple harmonic motion.

**UNIT I**

Forces at a Point: Parallelogram law of forces – Triangular law of forces – Perpendicular triangular forces – Converse of the triangular law of forces – The polygon of forces – Lami's theorem Parallel Forces & Moments: Like and unlike parallel forces – Problems – Moments – Definition – Varignon's theorem – Problems.

Chapter II: sections 1 to 9, Chapter III: sections 1 to 12.

**UNIT II**

Friction: Introduction – Experimental Results – Statical and Dynamical limiting friction – coefficient of friction – angle of friction – Cone of friction – Equilibrium of a particle on a rough inclined plane – Equilibrium of a particle on a rough inclined plane under a force parallel to the plane – Equilibrium of a particle on a rough inclined plane under any force – Problems.

Chapter VII: section 1 to 12.

**UNIT III**

Projectiles: Definitions – Two fundamental principles – The path of a projectile is a parabola – Characteristics of the motion of a projectile – Range on an inclined plane.

Chapter VI: Sections 6.1 to 6.8, 6.12 to 6.16

**UNIT IV**

Impulsive Forces: Impulse – Impulsive Force – Impact of two bodies – motion of a shot and Gun – Loss of Kinetic energy.

Collision of elastic bodies: Definitions – Fundamental Laws of Impact – Impact of a smooth sphere on a fixed smooth plane – Direct impact of two smooth spheres – Oblique impact of two smooth spheres.

Chapter – VII Sections 7.1 to 7.6, Chapter – VIII Sections 8.1 to 8.9

**UNIT V**

Simple Harmonic Motion: Simple Harmonic motion in a straight line – General solution of the S.H.M. equation – Geometrical representation – Change of origin – S.H.M. on a curve – simple pendulum – period of oscillation of a simple pendulum – equivalence simple pendulum – seconds pendulum – loss or gain in the number of oscillation made by a pendulum.

Chapter – X Sections 10.1 to 10.5, 10.11 – 10.16

**TEXT BOOK:**


1. Venkatraman.M.K., Statics, (Tenth Edition), Agasthiar Publication, Trichy 2002.
2. Venkatraman. M.K., 2009, Dynamics (Tenth Edition), Agasthiar Publications, Trichy.


**REFRENCE BOOK:**

1. Duraipandian. P., 1988, Mechanics, Emerald Publishers, Chennai.

**COURSE OUTCOME**

| | |
|---|---|
| CO1 | To recollect the basic concept of forces and understand the Varignon's theorem. |
| CO2 | To understand the laws of friction and equilibrium of a particle on a rough inclined plane under a force |
| CO3 | To understand the path of a projectile is a parabola and to apply the concept of projectile. |
| CO4 | To understand the impulse and impulsive force and to gain knowledge about collision of elastic bodies. |
| CO5 | To understand the geometrical representation of simple harmonic motion and solve the problems on the seconds pendulum. |

## SEMESTER V

# SBEC III – C – Programming (Theory)

## Paper Code: 21UMAS02 Max. Marks: 75

**COURSE OBJECTIVE**

C is a versatile language suitable for virtually any programming task and it has replaced FORTRAN for solving problems. 'C' is the primary programming language, used when writing software for OSX and IOS and also its higher version C++ provides object oriented capabilities. The main objective of this course is to learn how to write programs in C language for solving mathematical problems.

**UNIT I**

Basic structure of C Program – Character set, constants - Keywords and identifiers – variables – data type – declaration of variables- assigning values to variables – Defining symbolic constants.

Chapter 2: (Sections 2.1to 2.11)

**UNIT II**

Arithmetic operators – relational operators - logical operators – assignment operators' increment and
decrement operators - conditional operators – special operators – arithmetic expressions – type conversions in expressions.

Chapter 3: (Sections 3.2 to 3.14)

**UNIT III**

Reading a character – writing a character – formatted input and output – decision making with IF statement – Simple IF statement – IF ELSE statements - Nesting of IF …….. ELSE statement – Switch statement – The GOTO statement – the WHILE statement – The DO statement – The FOR statement – Jumps in loops.

Chapter 4, 5 & 6: (Sections 4.2 to 4.5, 5.2 to 5.7, 5.9, 6.2 to 6.5)

**UNIT IV**

One dimensional array – Two dimensional arrays – initializing two dimensional arrays – multi dimensional arrays – declaring and initializing string variables – reading strings from terminal – writing strings to screen – Arithmetic operations on characters.

Chapter 7 & 8: (Sections 7.2 to 7.7, 8.2 to 8.5)

**UNIT V**

Need for user defined functions – A multi function program – The form of C functions – Return values and their types – calling a function – Category of functions – no arguments and no return values.

Chapter 9: (Sections 9.2 to 9.10)

**TEXT BOOK:**

1. E. Balagurusamy, Programming in ANSI C Tata McGraw – Hill publishing company Limited, New Delhi.

**REFERENCE BOOKS:**


1. C.Xavier C. Language and Numerical Methods, Year of publication 1999 - New age international limited, New Delhi.
2. Kernighan B.W. and Retchie D.M. THE C PROGRAMMING LANGUAGE, prentice hall India, New Delhi 1997.


**COURSE OUTCOME**

On successful completion of this course students will be able to

- Understand the structure of C program, its keywords, declaration of variables and defining symbolic commands.
- Use arithmetic operators, logical operators, relational operators, increment and decrement operators and conditional operators while writing a C program.
- Know the decision making using IF statement, IF ELSE statement, and to have jumps in loops using GOTO, WHILE, DO, FOR and SWITCH statement.
- Define one dimensional array, two dimensional arrays, and to declare string variables.
- Understands the need for user defined functions, return values and their types, calling function, and category of functions.

# SEMESTER VI
# CORE XIII: LINEAR ALGEBRA

## Paper Code: 21UMA13 / 21UMACA13 Max. Marks: 75

**COURSE OBJECTIVE**

- To learn about Linear dependence, Bases and Dimension.
- To provide basic knowledge of Linear Transformations and Matrix representation.
- To introduce Inner product Spaces.

**UNIT – I**

**Vector Spaces:** Introduction - Vector spaces – Subspaces - Linear Combinations and Systems of Linear Equations - Linear Dependence and Linear Independence - Bases and Dimension.

(Chapter 1 : Sections 1.1 - 1.6 )

**UNIT – II**

**Linear Transformations and Matrices:** Linear Transformations, Null spaces and Ranges – The Matrix representation of a Linear Transformation – Composition of Linear Transformations and Matrix Multiplication – Invertibility and Isomorphisms

(Chapter 2: Sections 2.1 - 2.4)

**UNIT – III**

**Elementary Matrix Operations and System of Linear Equations:** Elementary Matrix Operations and Elementary Matrices – The Rank of a Matrix and Matrix Inverses - System of Linear Equations- Theoretical Aspects (excluding Application).

(Chapter 3: Sections 3.1 - 3.3)

**UNIT – IV**

**Inner Product Spaces:** Inner Products and Norms - The Gram-Schmidt Orthogonalization Process and Orthogonal Complements – The Adjoint of a Linear Operator.

(Chapter 6: Sections 6.1 - 6.3)

**UNIT – V**

Normal and Self adjoint operators – Unitary and Orthogonal operators and their Matrices (Excluding orthogonal operators on $R^2$)-Orthogonal Projections and The Spectral theorem.

(Chapter 6: Sections 6.4 - 6.6)

**TEXT BOOK:**

Stephen H. Friedberg , Arnold J. Insel , Lawrence E. Spence, ***Linear Algebra*** , Prentice-Hall India, Fifth edition.

**REFERRENCE BOOKS:**


1. Arumugam,S. and Issac,A. 2014.***Modern Algebra***. Scitech Publications (India) Pvt. Ltd. Chennai.
2. Sharma J.N. and Vashistha, A.R, 1981.***Abstract Algebra***. Krishna Prakasam Mandir, Meerut.

**COURSE OUTCOME**

After completion of the course, the students will be able to

| | |
|---|---|
| **CO 1** | Find the linear dependence and independence, dimension of spaces. |
| **CO 2** | Know the concepts of null spaces, range and Matrix representation of a linear transformation. |
| **CO 3** | Solve System of Linear equations by using Rank. |
| **CO 4** | Understand about Inner Product Spaces. |
| **CO 5** | Compute the orthogonal projection of a vector. |

## SEMESTER VI
## CORE XIV: REAL ANALYSIS – II

**Paper Code: 21UMA14 / 21UMACA14** **Max. Marks: 75**

**COURSE OBJECTIVE**

On Successful Completion of the course, the students will be able to

- Understand closed sets, Connected sets totally bounded sets.
- Understand the concepts of Complete, Compact metric spaces and uniform continuity.
- Understand the classical theory of Riemann Integration.
- To know how to apply Rolle's Theorem, Fundamental theorem of calculus.
- Understand the basic concepts of Uniform convergence and its applications.

**UNIT – I**

Closed Sets - Discontinuous functions on $R^1$-More about Open sets-Connected sets-Bounded sets & Totally bounded sets.
Section (5.5, 5.6, 6.1-6.3)

**UNIT – II**

Complete Metric spaces - Compact Metric spaces- Continuous functions on Compact Metric spaces - Continuity of the inverse functions - Uniform Continuity.
Section (6.4 - 6.8).

**UNIT – III**

Sets of Measure Zero - Definition of the Riemann Integral-Existence of the Riemann Integral -Properties of the Riemann Integral - Derivatives.
Section (7.1 - 7.5)

**UNIT – IV**

Rolle's theorem- The law of the mean-Fundamental theorems of calculus-Improper integral- Improper integral (continued).
Section (7.6-7.10)

**UNIT – V**

Point wise convergence of sequences of functions-Uniform convergence of sequences of functions- Consequences of Uniform convergence- Convergence and Uniform convergence of Series of functions-Integration and differentiation of series of functions
Section (9.1 - 9.5)

## TEXT BOOK:

| S.No | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | Methods of Real Analysis | Richard R.Goldberg | IBM Publishing New Delhi. | 1970 |

## REFERENCE BOOKS:

| S.No | Title of the Book | Author | Publishing Company | Year of Publication |
|---|---|---|---|---|
| 1. | A First Course in Real | Sterling K.Barberian | Springer(India) Private Limited ,New Delhi. | 2004 |

| | | | | |
|---|---|---|---|---|
| | Analysis | | | |
| 2. | Mathematical Analysis | Tom.M.Apostel | Narosa Publications,NewDelhi | 2002 |
| 3. | Real Analysis | M.S.Rangachari | New Century Book House,Chennai. | 1996 |

**COURSE OUTCOME**

After completing the course the students will be able to

- Understand concepts of connectedness, completeness and compactness of metric spaces.
- Understand basic concepts of Riemann Integration and solving simple problems.
- Solving problems by using theorems on derivatives.

# SEMESTER VI

# CORE XV: COMPLEX ANALYSIS

## Paper Code: 21UMA15 / 21UMACA15 Max. Marks: 75

### COURSE OBJECTIVE

- To enable the students to identify Analytic functions
- To enrich the knowledge on Cauchy Integral formula and Fundamental theorems.
- To introduce the concepts of Singularities and Residues.

**UNIT-I**

**Analytic Functions:** Functions of a Complex variable - Limits - Theorems on Limits - Limits involving the Point at Infinity – Continuity – Derivatives - Cauchy - Riemann Equations - Sufficient Conditions for Differentiability - Polar Coordinates - Analytic Functions – Examples - Harmonic Functions.

(Chapter 1: Sections 12,15 to 19,21 to26).

**UNIT-II**

**Integrals:** Contours-Contour Integrals-Some examples-Cauchy - Goursat Theorem-Proof of the Theorem-Simply Connected Domains-Multiply Connected Domains-Cauchy Integral Formula-An Extension of the Cauchy Integral Formula- Liouville's Theorem and the Fundamental Theorem of Algebra.

(Chapter 4: Sections 39 to 41,46 to 51,53).

**UNIT-III**

**Series:** Convergence of Sequences-Convergence of Series- Taylor Series-Proof of Taylor's Theorem-Examples-Laurent Series-Proof of Laurent's Theorem- Examples.

(Chapter 5: Sections 55 to 62)

**UNIT-IV**

**Residues and Poles:** Isolated Singular Points- Residues- Cauchy Residue Theorem-Residue at Infinity- The Three Types of Isolated Singular Points- Residues at Poles- Examples-Zeros of Analytic Functions-Zeros and poles.

(Chapter 6 :Sections 68 to 76).

**UNIT-V**

**Mapping by Elementary Functions:** Linear Transformations-The Transformation w=1/z - Mappings by 1/z – Linear Fractional Transformations – An Implicit Form. **Conformal Mapping:** Preservation of Angles- Scale Factors-Local Inverse.

(Chapter 8: Sections 90 to 94, Chapter 9: Sections 101 to 103).

### TEXT BOOK

1. James Ward Brown and Ruel V.Churchill, ***Complex Variables and Applications***, McGraw Hill,Inc., Eighth Edition.

### REFERRENCE BOOKS

1. T.K.Manickavachagam Pillai, ***Complex Analysis***, S.Viswanathan Publishers Pvt.Ltd.
2. Duraipandian,P. and Laxmi Duraipandian.2001. ***Complex Analysis***, Emerald Publishers, Chennai.

### COURSE OUTCOME

After completion of the course, the students will be able to

| | |
|---|---|
| **CO 1** | Know the concepts of Limits, Continuity and Analytic functions. |
| **CO 2** | Solve Complex Integrals. |
| **CO 3** | Discuss Convergence of Sequences and Series, Taylors series and Laurents series. |
| **CO 4** | Find different Singularities and Residues |
| **CO 5** | Understand various Linear Transformations and Conformal Mappings |

## SEMESTER VI
## CORE XVI: GRAPH THEORY

**Paper Code: 21UMA16 / 21UMACA16** **Max. Marks: 75**

**COURSE OBJECTIVE**

- To understand the basic concepts of graph theory, vertex connectivity and edge connectivity in graph.
- To understand the concept of Euler Graphs and Hamilton Graphs.
- To understand the concept of trees and matrices in Graphs like incidence matrix, adjacency matrix etc.,
- To understand the concept of directed graphs, directed paths and Euler Digraphs.

### UNIT – I

Introduction -Definition - Application of Graphs- Finite and Infinite Graphs- Incidence and Degree- Isolated Vertex- Pendant vertex- Null Graph. Paths and circuits- Isomorphism- Sub graphs- A puzzle with multicolored Cubes -Walks, Paths and Circuits.

Chapter 1: Sections: 1-2, 1-3, 1-4 and 1-5.

Chapter 2: Sections: 2-1, 2-2, 2-3.

### UNIT – II

Connected Graphs- Disconnected Graphs and Components- Euler Graphs-Operation on Graphs - More on Euler Graphs- Hamiltonian paths and circuits- The Travelling Salesman Problem.

Chapter 2: Sections: 2-4, 2-5, 2-6, 2-7, 2-8, 2-9 and 2-10.

### UNIT – III

Trees: Properties of Trees- Pendant Vertices in trees- Distance and centersin a Tree- Rooted and Binary Trees- On Counting Trees- Spanning Trees- Fundamental Circuits.

Chapter 3: Sections: 3-1, 3-2, 3-3, 3-4, 3-5, 3-6, 3-7 and 3-8.

### UNIT – IV

Matrix representation of graph: Incidence Matrix-Sub matrix of A(G)- Circuit matrix- Fundamental circuit matrix and rank of B-Path matrix- AdjacencyMatrix.

Chapter 7: Sections: 7-1, 7-2, 7-3 and 7-4, 7-8, 7-9.

### UNIT – V

Directed Graphs: Definitions- Types of Digraphs- Digraph and Binary Relations- Directed Paths and Connectedness- Euler Digraphs- Trees with Directed Edges.

Chapter 9: Sections: 9-1, 9-2, 9-3, 9-4, 9-5 and 9-6.

### TEXT BOOK:

1. Narasingh Deo, Graph Theory with application to Engineering and Computer Science, Prentice – Hall of India Private Limited, New Delhi.

## REFERENCE BOOK:

1. Harary, Graph Theory, Narosa Publications, New Delhi.

2. S. Arumugam, S. Ramachandran, Invitation to Graph Theory, ScitechPublications, Chennai-2001.

3. JohnClark, A First Look at Graph Theory, Allied Publication Ltd,Madras

**COURSE OUTCOME**

After completing the course**,** Students will be able to

- Formally understand and prove theorems and lemmas.
- Apply theoretical knowledge acquired to solve realistic problems in real life.
- Apply principles and concepts of graph theory in practical situations and to improve the proof writing skills.

## SEMESTER VI
## SBEC IV: OFFICE AUTOMATION (PRACTICAL)

**Paper Code: 21UMASP03** **Max. Marks: 75**

**COURSE OBJECTIVE**

- To learn about basic commands of MS Word, MS Excel and MS Access.

**LIST OF PRACTICALS**

**MS Word**

1. Preparation of word document (Typing, aligning, Font Style, Font Size, Text editing, colouring, Spacing, Margins)
2. Creating and Editing a table (Select no of rows, Select no of columns, row heading, column heading, column width, row width, row height, spacing text editing)
3. Formatting a table (insert rows/columns, delete rows/columns, cell merging / splitting, Cell alignment)
4. Preparation of letters using mail merge.
5. Demonstration of Find, Replace, Cut, Copy and paste texts in a word document.

**MS Excel**

6. Creation of Charts, Graphs and Diagrams.
7. Calculation of Measures of central Tendency
8. Calculation of Standard Deviation.

**MS Power Point**

9. Preparation of slides in power point.
10. Creation of Animation Pictures.

**MS Access**

11. Creation of simple reports using MS Access.

**General**

12. Exporting a given graph from Excel to word.
13. Sending an Email.
14. Downloading a document from internet.
15. Importing a picture from internet to word document.

## TEXT BOOK:

1. Andy Channelle, ***Beginning Open Office 3: From Novice to Professional***, A Press series,

Springer-Verlog, 2009.

## REFERENCE BOOK:

1. Perry M. Greg, ***Sams Teach Yourself Open Office.org All In One***, Sams Publications, 2007.

**COURSE OUTCOME**

Acquire practical knowledge about MS-Word, MS-Excel, MS-PowerPoint and Ms-Access.

# ELECTIVE COURSE – I
# GROUP A
## ELECTIVE – DISCRETE MATHEMATICS

**Paper Code: 21UMAE01** **Max. Marks: 75**

**COURSE OBJECTIVE**

The course aims to

1. gain knowledge about the concepts of Mathematical logic and algebraic structures.
2. know about the relations, functions and axioms related to natural numbers.
3. understand the concepts of Lattices and Boolean Algebra.

**Syllabus**

**UNIT – I**

Mathematical logic – Statements and Notations – Connectives – Negation – Conjunction – Disjunction – Statement formulas and truth table – Conditional and Bi-conditional – Well formed formulas – Tautologies.

Chapter 1(sections 1.1, 1.2.1 to 1.2.4, 1.2.6 to 1.2.8)

**UNIT – II**

Normal forms – Disjunctive Normal forms – Conjunctive Normal forms – Principal Disjunctive Normal forms – Principal conjunctive Normal forms - Ordering and uniqueness of normal forms – Validity using truth tables – Rules of inference.

Chapter 1(sections 1.3.1 to 1.3.5, 1.4.1, 1.4.2)

**UNIT – III**

Relations and Ordering – Relations – Properties of Binary binary relations in a set – Partial Ordering – Partially ordered set: Representation and Associated terminology – Functions: Definition and Introduction – Composition of functions – Inverse functions – Natural numbers: Peano axioms and Mathematical induction.

Chapter 2 (sections 2.3.1, 2.3.2, 2.3.8, 2.3.9, 2.4.1 to 2.4.3, 2.5.1)

**UNIT – IV**

Algebraic systems: Definition and examples - Semigroups and Monoids: Definition and examples – Homomorphism of Semigroups and Monoids – Subsemigroups and Submonoids.

Chapter 3 (sections 3.1.1, 3.2.1, 3.2.2 and 3.2.3)

**UNIT – V**

Lattices as partially ordered sets: Definition and examples – Some properties of Lattices – Sub lattices, Direct product and Homomorphism – Boolean algebra: Definition and examples – Sub Algebra, Direct product and Homomorphism.

Chapter 4 (sections 4.1.1, 4.1.2, 4.1.4, 4.2.1, 4.2.2)

**TEXT BOOK:**

1. J.P. Tremblay, R. Manohar, Discrete Mathematical structure with Applications to computer science, Tata Mc Graw hill, 2001.

**REFERENCE BOOKS:**

1. Dr.M.K. Sen and Dr. B.C. Charraborthy, Introduction to Discrete Mathematics, Arunabha Sen Books & allied Pvt.Ltd, 8/1, Chintamoni Das Lane, Kolkatta – 700 009.

## COURSE OUTCOME

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

| | |
|---|---|
| CO 1 | Recall the various concepts of Mathematical Logic |
| CO 2 | Understand the concepts of different types of normal forms |
| CO 3 | Classify the various types of functions and make them to use in practical applications related to computer science |
| CO 4 | Gain knowledge about the Algebraic systems |
| CO 5 | Understand the concepts of Boolean Algebra and its applications |

# GROUP A
## ELECTIVE – ASTRONOMY

**Paper Code: 21UMAE02** **Max. Marks: 75**

**COURSE OBJECTIVE**

This paper focuses on enabling the students to learn about the solar system, its components and interesting facts about the solar system.

**UNIT – I**

The solar System: Introduction - The Sun – Mercury – Venus – Mars – Asteroids – Jupiter – Saturn – Uranus – Neptune.

Chapter 16 Sections: 316-326. Pg.No : 455 –467

**UNIT - II**

The Solar System: Comets - Meteors - Zodiacal light.

Chapter 16 Sections: 327-329. Pg.No : 467 –472

**UNIT – III**

Double And Multiple Stars: Introduction - Variables stars - Eclipsing Variables Cepheid variables – Long period variables - Irregular variables - Novae - Star clusters Nebulae - Constellations - Zodiacal Constellations.

Chapter 17 Sections: 339–345. Pg.No : 481-489

**UNIT – IV**

The Milky Way: Introduction - Seasonal changes in the night sky - The winter Constellations - The spring Constellations.

Chapter 17 Sections: 346–347. Pg.No : 489 –497

**UNIT – V**

Constellations: Introduction - The summer Constellations - The autumn Constellations.

Chapter 17Sections:347. Pg.No : 497 –504

**TEXT BOOK:**

1. Kumaravelu S and Susheela Kumaravelu," Astronomy for degree classes", 7th edition 1986.

**REFERENCE BOOK:**

1. V.B.Bhatia, Text book for Astronomy and Astrophysics with elements of Cosmology.

2nd Edition Narosa Publishing House, New Delhi, 2001.

**COURSE OUTCOME**

- Gain knowledge about solar system.
- Gain knowledge about double & multiple stars.

# GROUP A
## ELECTIVE – JAVA PROGRAMMING

**Paper Code: 21UMAE03** **Max. Marks: 75**

### COURSE OBJECTIVE

- Programming in the JAVA Programming language.
- Knowledge of object – oriented paradigm in the JAVA Programming language.
- The use of JAVA in a variety of technologies and on different platforms.

### UNIT – I

Basic concepts of object – oriented programming – objects and classes – Data Abstraction and Encapsulation – Inheritance – polymorphism – Dynamic Binding – Message communication – Java features – Java Environment – Java Program structure – Java Virtual Machine.

### UNIT – II

Introduction–Constants–Variables–Data types–Declaration of variables–scope of variables –type casting – operators and expressions – Decision making and branching–Decision making and looping.

### UNIT – III

Classes – Objects and Methods – Arrays – Strings – Interfaces – Multiple inheritance.

### UNIT – IV

Packages – Multi-threaded Programming – Managing Errors and Exceptions.

### UNIT – V

Applet Programming – Introduction–Building Applet code – applet lifecycle–Creating an executable applet – Designing a web page – Applet tag – adding applet to HTML file – Running the Applet – Managing I/O files in Java.

### TEXT BOOK

1. E. Balagurusamy, Programming with Java a Printer, Tata McGraw Hill Publications Co., Ltd., New Delhi,1998.

### REFERENCE BOOKS

1. Pootrick Naughton and Hebert Schedelt, The Complete Reference Java – 2, Tata McGraw Hill PublicationsCo.,Ltd.,NewDelhi,3rd Edition,2006.
2. HebertSchedelt,Java–4th Edition.

**COURSE OUTCOME**

- Understand fundamentals of programming such as Variables, Conditional and iterative execution, methods etc.
- Understand fundamentals of object – oriented Programming in JAVA, including defining classes, invoking methods, using class libraries, utilities in applets etc.
- Be aware of the important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Be able to use the JAVA SDK environment to create, debug and run simple JAVA programs.

NOTE:

- This paper should be handled and valued by the faculty of Mathematics only.
- Both Internal and External Examiners for University Practical Examination should be appointed from faculty of Mathematics only.

# ELECTIVE COURSE – II
# GROUP B
## ELECTIVE – FUZZY SETS AND FUZZY LOGIC

**Paper Code: 21UMAE04** **Max. Marks: 75**

**COURSE OBJECTIVE**

- To understand uncertainty
- Fuzzy logic attempts to emulate reasoning and decision making in an uncertainenvironment
- Knowledge in set theory

**UNIT – I**

**From Classical (Crisp) Sets to Fuzzy Sets:** Introduction –*Crisp sets: An Overview*. Fuzzy Sets: Basic Types – Fuzzy Sets: Basic Concepts – Characteristics and Significance of the Paradigm Shift – **Fuzzy Sets versus Crisp sets**: Additional Properties of $\alpha$ −Cuts – Representations of Fuzzy Sets. Extension Principle for Fuzzy Sets.

Chapter 1: 1.1 – 1.5 & Chapter 2: 2.1 – 2.3

UNIT – II

**Operations on Fuzzy Sets**: Types of Operations – Fuzzy Complements – Fuzzy Intersections: *t* – Norms – Fuzzy Unions: *t*–Conorms – Combinations of Operations – Aggregation Operations

Chapter 3:3.1 – 3.6

**UNIT – III**

**Fuzzy Arithmetic**: Fuzzy Numbers – Linguistic Variables – Arithmetic Operations on Intervals, Fuzzy Numbers – Lattice of Fuzzy Numbers. Fuzzy Equations.

Chapter 4: 4.1 – 4.6

**UNIT – IV**

**Fuzzy Relation**: Crisp Versus Fuzzy Relations – Projections and Cylindric Extensions – Binary Fuzzy Relations – Binary Relations on a Single Set – Fuzzy Equivalence Relations – Fuzzy Compatibility Relations – Fuzzy Ordering Relations – Fuzzy Morphisms – Sup–i Compositions atFuzzy Relations – Inf–$\omega_i$ Compositions of Fuzzy Relations.

Chapter 5: 5.1 – 5.10

**UNIT – V**

**Fuzzy Logic:** Classical logic: An Overview – Multivalued Logics – Fuzzy Propositions – Fuzzy Quantifiers – Linguistic Hedges – Inference from Conditional Fuzzy Propositions – Inference from Conditional and Qualified Propositions – Inference from Quantified Propositions.

Chapter 8: 8.1 – 8.8

**TEXT BOOK**

| S.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1. | George Klir J. and Bo Yuan | Fuzzy Sets and Fuzzy Logic: Theory and Applications | Prentice Hall of India Private Limited, New Delhi | 2008, 1st Edition |

**REFERENCE BOOKS**

| S.No. | Author Name | Title of the Book | Publisher | Year and Edition |
|---|---|---|---|---|
| 1. | George J. Klir, Tina A.Folger | Fuzzy sets, uncertainty and information | Prentice Hall of India Ltd, New Delhi | 2006, 1st edition |
| 2. | Zimmermann H.J. | Fuzzy set Theory and its Applications | Springer Private Limited, New Delhi | 2006, 4th edition |
| 3. | Zimmermann H.J | Fuzzy sets, Decision Making, and Expert Systems | Kluwer, Boston | 1993, 4th edition |

## Pedagogy

Lecture, PPT, Quiz, Group Discussion, Seminar and Case Study

## Web Resources

1. https://www.journals.elsevier.com/fuzzy–sets–and–systems
2. https://www.ifi.uzh.ch/fuzzylogicscrip
3. http://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_control_systemhttps://www .cse.iit b.ac.in/~cs621–2011/lectures_2009/cs621–lect38–fuzzy–logic

**COURSE OUTCOME**

On the successful completion of the course, students will be able to

| CO Number | CO Statement |
|---|---|
| **CO1** | Calculate support, height, normal alpha cuts and strong alpha cuts from the Membership Functions |
| **CO2** | Manipulate standard fuzzy operations such as complements, *t* – norms and *t* – conorms |
| **CO3** | Analyze the concepts of fuzzy numbers and linguistic variables |
| **CO4** | Compute fuzzy relations for equivalence and compatibility |
| **CO5** | Apply the concepts of fuzzy logic, fuzzy propositions and quantified propositions to mathematical modeling in uncertain situation |

# GROUP B
## ELECTIVE – Formal Languages and Automata Theory

**Paper Code: 21UMAE05** **Max. Marks: 75**

**COURSE OBJECTIVE**

- This course will give an introduction to formal languages and automata theory. Automata and formal languages appear (possibly in various disguises) in almost every branch of computer science.
- The purpose of this course is to acquaint the student with an overview of the theoretical foundations of computer science from the perspective of formal languages.

**UNIT – I**

Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, transition diagrams and Language recognizers.

Finite Automata: NFA with Î transitions - Significance, acceptance of languages. Conversions and Equivalence: Equivalence between NFA with and without Î transitions, NFA to DFA conversion, minimisation of FSM, equivalence between two FSM's, Finite Automata with output- Moore and Melay machines.

**UNIT – II**

Regular Languages: Regular sets, regular expressions, identity rules, Constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions. Pumping lemma of regular sets, closure properties of regular sets (proofs not required).

Grammar Formalism: Regular grammars-right linear and left linear grammars, equivalence between regular linear grammar and FA, inter conversion, Context free grammar, derivation trees, sentential forms. Rightmost and leftmost derivation of strings.

**UNIT – III**

Context Free Grammars : Ambiguity in context free grammars. Minimisation of Context Free Grammars. Chomsky normal form, Greiback normal form, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted).

Push Down Automata : Push down automata, definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. Equivalence of CFL and PDA, interconversion. (Proofs not required). Introduction to DCFL and DPDA.

**UNIT – IV**

Turing Machine: Turing Machine, definition, model, design of TM, Computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing machines (proofs not required).

**UNIT – V**

Computability Theory: Chomsky hierarchy of languages, linear bounded automata and context sensitive language, LR(0) grammar, decidability of, problems, Universal Turing Machine, undecidability of posts. Correspondence problem, Turing reducibility, Definition of P and NP problems, NP complete and NP hard problems.

## TEXT BOOKS


1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory Languages and Computation", 3rd Edition, 2006, Pearson Education (Addison Wesley).
2. Michael Sipser, "Introduction to the Theory of Computation", 2nd Edition, 2006, Thomson


## REFERENCES


1. Daniel I.A. Cohen, Introduction to Computer Theory, 1986,John Wiley & Sons, Inc.. (https://pakistandasti.files.wordpress.com/2013/11/introduction-to-computer-theory-by-cohen-copy.pdf)
2. John C Martin, Introduction to languages and the Theory of Computation,4th Edition, 2003, McGraw Hill (https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.465.3774&rep=rep1&type=pdf)
3. Harry R. Lewis, Christos H. Papadimitriou, Elements of Theory of Computation, 2nd Edition, 1998, Prentice-Hall, Upper Saddle River, New Jersey. (https://www.ucursos.cl/ingenieria/2010/2/CC3102/1/material_docente/bajar?id_material=3222

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## COURSE OUTCOME

- Gain knowledge about the Grammars, Languages and Automata Theory.
- Understanding the features of Turning Machine and Computability Theory

# GROUP B
## ELECTIVE – C++ PROGRAMMING

**Paper Code: 21UMAE06** **Max. Mark: 75**

**COURSE OBJECTIVE**

The Course aims are to

1. Understanding about object-oriented programming
2. Create and process data in files using I/O functions
3. Understand about constructors which are special type of functions.

## UNIT- I

Basic Concepts of Object-Oriented Programming – Tokens – Expressions – Control Structures – Functions in C++.

Chapter 1: Sec.1.5, Chapter 3:Sec 3.1 – 3.24

Chapter 4: Sec 4.1- 4.11

## UNIT- II

Classes & Objects.

Chapter 5: Sec.5.1 – 5.16

## UNIT- III

Constructors & Destructors.

Chapter 6: Sec 6.1 – 6.11

## UNIT- IV

Operator Overloading – Type Conversions.

Chapter 7: Sec.7.1 – 7.8

## UNIT- V

Inheritance & Extending classes – Pointers, Virtual Functions and Polymorphism.

Chapter 8: Sec.8.1 – 8.12, Chapter 9: Sec.9.1 – 9.3, 9.5 – 9.7

## TEXT BOOK:

1. Object Oriented Programming with C++, E. Balagurusamy, Tata McGraw, Hill, 2006. Fourth Edition.

**COURSE OUTCOME**

- Understand the Basic concepts of object oriented programme, Expressions, control structures, Classes and objects.
- Understand dynamic memory management techniques using constructors, destructors, etc.
- Understand the concept of function overloading, operator overloading, virtual functions and polymorphism.
- Demonstrate the use of various OOPs concepts with the help of programs.

# ALLIED MATHEMATICS

(For B.Sc. PHYSICS / B.SC COMPUTER SCIENCE / B.SC. CHEMISTRY)

## SEMESTER - I / III

## ALLIED MATHEMATICS – I

## ALGEBRA AND CALCULUS

**Paper Code: 21UMAA01** **Max. Marks: 75**

## COURSE OBJECTIVE

- To learn the basic concepts and problem solving in Theory of equations.
- Develop the ability of solving the Integrals.

## UNIT – I: Theory of Equations:

Imaginary roots - Irrational roots -Formation of equations -Solution of equations- Diminishing the roots of an equation & solutions - Removal of the second term of an equation & solutions - Descarte's rule of sign - Problems only.

**UNIT – II: Matrices:**

Definition of Characteristic equation of a matrix - Characteristic roots of a matrix - Eigen values and the corresponding Eigen vectors of matrix — Cayley Hamilton theorem (Statement only) — Verifications of Cayley Hamilton Theorem—Problems only.

**UNIT – III: Radius of Curvature:**

Formula of Radius of Curvature in Cartesian coordinates, Parametric coordinates and Polar coordinates (no proof for formulae) - Problems only.

**UNIT** – IV: Partial Differential **Equations:**

Formation of Partial Differential Equations by eliminating the arbitrary constant and arbitrary functions - Lagrange's Linear Partial Differential Equations - Problems only.

**UNIT – V: Integration:**

Definite Integral: Simple properties of definite Integrals-Bernoulli's Formula - Integration by parts- Simple problems; Reduction formula for $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, $\int_0^{\frac{\pi}{2}} cos^n x\ dx$, $\int_0^{\infty} e^{-x} dx$ , $\int x^n e^{ax}\ dx$ simple problems

**TEXT BOOK**:


1. Dr P R .Vittal ,Allied Mathematics, Margham publication, Chennai-17, Reprint 2012

**REFERENCE BOOK:**

1. S G Venkatachalapathi, Allied Mathematics, Margham publication, Chennai-l7,Reprint 2011.

**COURSE OUTCOME**

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

| | |
|---|---|
| CO 1 | Know the application of relations between the roots and coefficients of an equation and diminishing the roots of an equation |
| CO 2 | Ability to solve the consistency of linear equations and application of Cayley-Hamilton theorem |
| CO 3 | Understanding the concepts of Cartesian co-ordinates, parametric co-ordinates and polar co-ordinates. |
| CO 4 | Understand the basic properties of PDE. |
| CO 5 | Gain the skill to solve problems. |

## SEMESTER II / IV

## ALLIED MATHEMATICS – II

## DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORMS

**Paper Code: 21UMAA02** **Max. Marks: 75**

## COURSE OBJECTIVE

- Develop the basic concepts of Maxima and Minima of two variables and Numerical methods problems.
- To learn the second order differential equation with constant coefficients.
- To learn the basic concepts of Laplace Transforms, Inverse Laplace Transforms & Applications.

**UNIT – I**

Jacobian and Maxima & Minima: Jacobian of two variables and three variables - Maxima and Minima of functions of two variables -Problems only.

**UNIT – II**

Finite Differences: First difference- Higher differences - Construction of difference table - Interpolation of missing value-Newton's Forward and Newton's Backward difference formula (no proof)-Lagrange's Interpolation formula (no proof)- simple problems only.

**UNIT – III**

Second Order Differential Equations: Second Order Differential Equations with constant coefficients- Complementary function-particular Integral and Solution of the type: $e^{ax}$ , $x^n$ , cos ax (or) sin ax, $e^{as}x^{bs}$, $e^{as}$sin bx , $e^{as}$cos bx - only

**UNIT – IV**

Laplace Transforms: Definition of Laplace Transforms - standard formula -Linearity property – Shifting property - Change of scale property - Laplace Transforms of derivatives- Problems.

**UNIT – V**

Inverse Laplace Transforms: Standard formula - Elementary theorems (no proof) - Applications to solutions of second order differential equations with constant coefficients -Simple problems.

**TEXT BOOK:**

**1.** Dr.P.R .Vittal ,Allied Mathematics, Margham publication, Chennai-17, Reprint 2012

**REFERENCE BOOK:**

**1.** S.G.Venkatachalapathi, Allied Mathematics, Margham publication, Chennai-17,Reprint 2011.

**COURSE OUTCOME**

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

| | |
|---|---|
| CO 1 | Understanding the concepts of Maxima and Minima. |
| CO 2 | Developing the knowledge in Numerical Methods problem solving. |
| CO 3 | Understanding the second order differential equations with constant coefficients. |
| CO 4 | Understand the basic properties of Laplace Transforms. |
| CO 5 | Solving the simple problems in inverse Laplace and its applications. |

## SEMESTER - II / IV

## ALLIED MATHEMATICS - III – PRACTICALS

**Paper Code: 21UMAAP01** **Max. Marks: 75**

## COURSE OBJECTIVE

- Acquire knowledge about Matrices and Cayley-Hamilton Theorem.
- Understand the concepts of differentiation and Vector point functions.

**UNIT I: Matrices**:

Rank of Matrix – Problems upto (3x3) Matrix - Characteristic equation of a Matrix - Cayley Hamilton Theorem (statement only)-Problems to verify Cayley Hamilton Theorem.

**UNIT II: Leibnitz formula for $n^{th}$ derivative:**

Leibnitz formula (without proof) for $n^{th}$ derivative- Problems (Page no. 8.23 to 8.39 of the Text Book).

**UNIT III: Partial Differentiation:**

Euler's theorem on homogeneous function (without proof)- Problems to verify Euler's Theorem-Partial derivative - problems (Page no. 9.1 to 9.13 and 9.18 to 9.27 of the Text Book).

**UNIT IV: Scalar and Vector point functions:**

Scalar point functions -Gradient of scalar point functions - Vector point functions - Problems only.

**UNIT V: Divergence and Curl of Vector point functions:**

Divergence of vector point functions - Curl of vector point functions -Solinoidal of vector - Irrotational of vector - Problems only.

**TEXT BOOK:**

1. Dr.P.R .Vittal ,Allied Mathematics, Margham publication, Chennai-17, Reprint 2012

**REFERENCE BOOK:**

1. S.G.Venkatachalapathi, Allied Mathematics, Margham publication, Chennai-17, Reprint 2011.

**COURSE OUTCOME**

- Gain the skill to solve the problems in Matrices.
- Gain knowledge to solve the problems in partial differentiation.
- Gain knowledge on the concept of divergence, curl and integration of vector point functions

**NOTE:**

1) University Examination will be conducted at the end of Second Semester/Fourth Semester,

2) **Two Teaching Hours** for Unit – I, II and III in the First Semester/Third Semester and **two Hours** for Unit
– IV and V in the Second Semester/Fourth Semester.

# B.Sc. MATHEMATICS
# SEMESTER III
# NON MAJOR ELECTIVE COURSE
# QUANTITATIVE APTITUDE- I - 21UMAN01

COURSE OBJECTIVE

- To enhance the problem-solving skills.
- To improve the basic mathematical skills to help students who are preparing for any type of competitive examinations.
- To develop knowledge in practicing quantitative aptitude objective type question and answer in individual for competitive exams, entrance exams and interviews.

UNIT – I

Numbers, H.C.F. and L.C.M. of Numbers.

UNIT – II

Decimal Fractions , Square Roots and Cube Roots.

UNIT – III

Averages and Problems on Ages.

UNIT – IV

Surds and Indices, Percentages

UNIT – V

Ratio and proportion, Chain Rule.

TEXT BOOK:

1. Dr. R.S. Aggarwal, Quantitative Aptitude, S. Chand and Company Ltd., New Delhi,Reprint 2013.

REFERENCE BOOK:

1. Abhijit Guha, Quantitative Aptitude Tata McGraw Hill Publishing Company Limited.,New Delhi. Reprint 2005

COURSE OUTCOME

After completion of this course, Students will be able to

- Make sense of problems, develop strategies to find solutions and persevere in solving them.
- Use appropriate technology in a given context.
- Critique and evaluate quantitative arguments that utilize mathematics, statistical and quantitative information.
- Solve problems in numbers, decimal fractions, square root and cube roots.

# B.Sc. MATHEMATICS
# SEMESTER – III
# NON - MAJOR ELECTIVE COURSE
# LINEAR PROGRAMMING – 21UMAN02

**UNIT - I**

Definition of O.R. - Graphical Method .

**UNIT - II**

Simplex Method using Slack and Surplus Variables.

**UNIT - III**

Transportation Problem - Definition - Finding initial basic feasible solution only by using North -West corner Rule - Vogel's Approximation Method - Lowest cost entry Method. (Minimization with balanced problems only).

**UNIT – IV**

Assignment Problem - Definition -Finding optimal solution by using Hungarian Method

**UNIT – V**

Sequencing Problem - Definition - N jobs to be operated on Two Machines-Problems.

**TEXT BOOK:**

1. G.V Shenoy, Linear Programming Methods and Applications, New Age International Publishers,Second Edition.

**REFERENCE BOOK:**

1. Gauss S.l., Linear Programming, McGraw-Hill Book Company.

2. Gupta P.K. and Hira D.S., Problems in Operation Research , S.Chand & Co.,

3. Kanti Swaroop, Gupta P.K. and Manmohan, Problems in Operation Research, Sultan Chand & Sons.

# B.Sc. MATHEMATICS
# SEMESTER- IV
# NON MAJOR ELECTIVE COURSE
# QUANTITATIVE APTITUDE – II – 21UMAN03

COURSE OBJECTIVE

1. To enhance the problem-solving skills.
2. To improve the basic mathematical skills to help students who are preparing for any type of competitive examinations.
3. To develop knowledge in practicing quantitative aptitude objective type question and answer in individual for competitive exams, entrance exams and interviews.

**UNIT – I**

Time and Work, Time and Distance.

**UNIT – II**

Problems on trains, Boat and streams.

**UNIT – III**

Alligation or mixture, Logarithms

**UNIT – IV**

Volume and Surface Areas, Calendar, Clocks.

**UNIT – V**

Height and Distances, Odd Man Out and Series.

**TEXT BOOK:**

1. Dr. R.S. Aggarwal, Quantitative Aptitude, S. Chand and Company Ltd., New Delhi, Reprint 2013.

**REFERENCE BOOK:**

1. Abhijit Guha, Quantitative Aptitude Tata McGraw Hill Publishing Company Limited, New Delhi. Reprint 2005.

**COURSE OUTCOME**

After completion of this course, Students will be able to,

- Make sense of problems, develop strategies to find solutions and persevere in solving them.
- Use appropriate technology in a given context.
- Solving the problem on time and work, time and distance, boat and stream.
- Solving the problem on logarithms, volume and surface area, height and distance, odd man out.

# B.Sc. MATHEMATICS
# SEMESTER- IV
# NON MAJOR ELECTIVE COURSE
# NUMERICAL METHODS – 21UMAN04

**UNIT – I**

Solutions to Algebraic equations only: By (i) Bisection Method (no proof) and (ii) Newton Raphson's Method (no proof) - Simple Problems only.

**UNIT - II**

Finite Differences: Definition- First difference -Higher differences- Construction of difference TableOperator $\Delta$, and E only- Interpolation of missing value-Expression of any value of y in terms of the initial value y -Simple problems.

**UNIT – III**

Newton's Forward difference Formula (without proof) - Construction of difference Table - Simple problems only.

**UNIT - IV**

Newton's Backward difference Formula (without proof) - Construction of difference Table—Simple problems only.

**UNIT - V**

Central difference Formula: Gauss's Forward and Gauss's Backward difference formula (without proof)- Stirling formula (without proof) - Simple problems only.

**TEXT BOOK:**

1 P.Kandasamy K.Thilagavathi, Calculus of Finite Differences and Numerical Analysis, S.Chand &. Company PVT.LTD, New Delhi-55,2003.

**REFERENCE BOOK:**

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Private Limited, 1999.

2. C.E. Froberg, Introduction to Numerical Analysis, II Edn., Addison Wesley, 1979.