Placed at the meeting of
Academic Council
held on 26.03.2018

APPENDIX - AI

MADURAI KAMARAJ UNIVERSITY

(University with Potential for Excellence)

B. Sc. Mathematics (Semester)

REGULATIONS AND SYLLABUS

(This will come into force from the academic year 2018-2019)

1. INTRODUCTION OF THE PROGRAMME:

The goal of the course is to help students to develop a valuable mental ability – A powerful way of thinking that our ancestors have developed over three thousand years. This course is designed with particular students in mind. People who want to develop or improve mathematics – based analytic thinking for professional or general life purposes. To achieve this aim, the first year of the course has very little traditional mathematical content, focusing instead on the thinking processes require for mathematics. The second year of the course provides mathematical thinking to succeed in their major. The third year of the course engages in thinking about mathematical ideas. After completing the course, one can apply effective strategies of thinking to approach questions in their lives with insight and innovation. Finally any one can think more effectively and imaginatively throughout their lives.

2. ELIGIBILITY FOR ADMISSION

Candidate should have passed the Higher Secondary Examination conducted by the Board of Higher Secondary Education, Government of Tamil Nadu or any other Examination accepted by syndicate, as equivalent thereto, with Mathematics as one of the subjects in Higher Secondary Education.

2.1 DURATION OF THE COURSE :

The students shall undergo the prescribed course of study for a period of three academic years (Six semesters).]

2.2. MEDIUM OF INSTRUCTION

English/Tamil

3. OBJECTIVES OF THE PROGRAMME:

- To provide students with a systematic understanding of core areas and to offer the students a range of ways to develop their skills and knowledge
- To lay a foundation for a wide choice of careers and particularly careers requiring problem solving abilities
- To provide the foundation for higher education in Mathematics

4. OUTCOME OF THE PROGRAMME :

The students will be capable of facing the competitive situation prevailing now and getting placement and have the capacity to go for higher education.

5, 6 and 7. SUBJECTS OF STUDY

The programme consists of various subjects. The following are the different categories:

1. Tamil
2. English
3. Core Papers
4. Allied Paper I (Physics/Computer Science)
5. Allied Paper II (Applications of Mathematics)
6. Non Major Elective
7. Environmental Studies
8. Value Education
9. Extension Activities

Non Major Elective:

The University shall provide all information to the non major elective subject. The students can choose their elective subject in the first semester.

8. UNITIZATION:

Each subject contains 5 units. Not only core subjects, but also all the subjects.

9. PATTERN OF SEMESTER EXAMINATION:

Internal	-	25 Marks
External	-	75 Marks
Total	-	100 Marks

10. SCHEME FOR INTERNAL ASSESSMENT:

Tests	-	10 Marks (Average of 2 tests)
Assignment	-	5 Marks
Peer Team Teaching	-	5 Marks
Seminar	-	5 Marks
Total	-	25 Marks

11. EXTERNAL EXAMINATION:

There shall be external examinations at the end of each semester, odd semesters in the month of November and even semesters in the month of April.

A Candidate who does not pass the examination may be permitted to appear in the failed subjects in the subsequent examinations. A candidate should get registered for the first semester examination.

Students must have earned 75% of attendance in each course for appearing for the examinations. Students who have earned more than 70% and less than 75% of attendance have to apply for condonation in the prescribed form with prescribed fee. Students who have earned more than 60% and less than 70% of attendance have to apply for condonation in the prescribed form with prescribed fee along with a medical certificate. Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester(s) after the completion of the programme.

12. QUESTION PAPER PATTERN

Part A

Each question carries equal marks
Ten objective type questions 10 x 1 = 10 marks
Two questions from each unit

Part B

Five questions (Either Or type) 5 x 7 = 35 marks
One question from each unit

Part C

Three questions out of five questions 3 x 10 = 30 marks
One question from each unit

13. SCHEME OF EVALUATION

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points.

Mark statement contains $CCPA = \frac{\sum(Marks\ X\ Credits)}{\sum(Credits)}$ where the summations cover all the papers appeared up to the current semester.

14. PASSING MINIMUM

The passing minimum is 40% (External minimum is 27 out of 75; No minimum for internal, but External + Internal should be at least 40)

14.1 Classification :

S.No.	Range of CCPA	Class
1.	40 & above but below 50	III
2.	50 & above but below 60	II
3.	60 & above	I

15. REVALUATION PROVISION

Candidates may apply for revaluation of the paper which was already valued, within ten days from the date of publication of the result in the university website along with required forms and fees.

16. TEACHING METHODOLOGY

Each subject is designed with lectures/assignments/peer team teaching/seminar etc. to meet effective teaching and learning.

17. TEXT BOOKS

List of text books will be given at the end of the syllabus of the each subject.

18. REFERENCE BOOKS

List of reference books are followed by the list of text books.

19. RE-TOTALING AND REVALUATION PROVISION

Students may apply for re-totaling and revaluation after declaration of result within 15 days.

20. TRANSITORY PROVISION

The candidates of previous syllabus scheme may be permitted to write exams in their own schemes up to the examinations of April 2020 as a transitory provision.

Subjects of Study in B. Sc (Mathematics)

Semester	Parts	Subjects	No.of. Courses	Hours per Six Working days	Credits	Max Marks
I	I	Tamil Paper I	1	6	3	100
	II	English Paper I	1	6	3	100
	III Core Subjects	1. Calculus	1	5	5	100
		2. Theory of Equations and Trigonometry	1	5	5	100
	Allied Subject I	Physics I	1	6	4	100
	IV Non Major Elective	Fundamentals of Mathematics	1	2	2	100
		Total	6	30	22	600

Semester	Parts	Subjects	No.of. Courses	Hours per Six Working days	Credits	Max Marks
II	I	Tamil Paper II	1	6	3	100
	II	English Paper II	1	6	3	100
	III Core Subjects	3. Differential Equations	1	5	5	100
		4. Analytical Geometry of 3D and Vector Calculus	1	5	5	100
	Allied Subject I	Physics II + Practical	2	6	3 + 1	100+ 100
	IV Non Major Elective	Quantitative Aptitude	1	2	2	100
		Total	7	30	22	700

Semester	Parts	Subjects	No.of. Courses	Hours per Six Working days	Credits	Max Marks
III	I	Tamil Paper III	1	6	3	100
	II	English Paper III	1	6	3	100
	III Core subject	5. Mechanics	1	6	6	100
	Allied Subject I	Physics III	1	6	4	100
	Allied Subject II	1. Programming in C	1	6	4	100
		Total	5	30	20	500

Semester	Parts	Subjects	No.of. Courses	Hours per Six Working days	Credits	Max Marks
IV	I	Tamil Paper IV	1	6	3	100
	II	English Paper IV	1	6	3	100
	III Core subject	6. Basics of Analysis	1	6	6	100
	Allied Subject I	Physics IV + Practical	2	6	3 + 1	100+ 100
	Allied Subject II	2. Programming in C++ + Practical	2	6	3 + 1	100+ 100
		3. Extension Activities	1		1	
		Total	8	30	21	700

Semester	Parts	Subjects	No.of. Courses	Hours per Six Working days	Credits	Max Marks
V	III Core Subjects	6. Modern Algebra	1	5	5	100
		7. Real Analysis	1	5	5	100
		8. Fundamentals of Statistics	1	5	5	100
		9. Operations Research	1	5	5	100
	Allied Subject II	2. Graph Theory	1	6	4	100
	IV Skill Based Subjects	1. Fourier Series and Laplace Transform	1	2	2	100
		2. Environmental Studies	1	2	2	100
		Total	7	30	28	700

Semester	Parts	Subjects	No.of. Courses	Hours per Six Working days	Credits	Max Marks
VI	III Core Subjects	10. Linear Algebra	1	5	5	100
		11. Complex Analysis	1	5	5	100
		12. Statistics	1	5	5	100
		13. Elective	1	5	4	100
	Allied Subject II	3. Numerical Methods	1	6	4	100
	IV Skill Based Subjects	3. Logic and Boolean Algebra	1	2	2	100
		4. Value Education	1	2	2	100
		Total	7	30	27	700

Syllabus for Core Subjects

Paper 1 – CALCULUS

Objectives:

1. **To introduce n^{th} derivative.**
2. **To introduce curvatures, evolutes and involutes.**
3. **To introduce double and triple integrals.**

UNIT I

Differentiation: Definition (Only) - Successive differentiation - Trigonometrical transformation - Formation of equations involving derivatives - Leibnitz formula - Meaning of the derivative - Geometrical interpretation - Meaning of the sign of the differential coefficient - Expansion of functions - Taylor's theorem - Cauchy's form of remainder - Taylor's and Maclaurin's series.

UNIT II

Maxima and Minima of functions of two variables - Envelopes - Curvature - Circle, radius and centre of curvature - Cartesian formula for the radius of curvature - Coordinates of centre of curvature – Evolute and Involute.

UNIT III

Radius of curvature in polar coordinates - p-r equation - Pedal equation of a curve - Definite integrals and their properties.

UNIT IV

Reduction formula for $x^n e^{ax}$, $x^n \cos ax$, $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$, $\tan^n x$, $\sec^n x$, $x^m (\log x)^n$, $e^{ax}\cos bx$ - Bernoulli's formula - Evaluation of double integral- Double integral in polar coordinates - Triple integral.

UNIT V

Change of variables - Jacobian - Change of variable in case of two variables and three variables - Beta and Gamma functions - Properties of Beta function - Relation between Beta and Gamma functions.

Text Book:

T. K. M. Pillai and S. Narayanan, Calculus, Volume I, II, S. Viswanathan Publishing Company, 2012.

Unit I: Chapter III, IV- Sections 2.1, 2.2, Chapter VII
Unit II: Chapter VIII - Sections 4, 4.1, Chapter X upto Section 2.5
Unit III: Chapter X – Sections 2.6, 2.7, Volume II, Chapter 1 - Section 11
Unit IV: Volume II Chapter 1 - Sections 13, 14, 15-1 and Chapter 5-Sections 1, 2, 3, 4
Unit V: Chapter 6 - Sections 1, 2, Chapter 7 - Sections 1, 2, 3, 4

Reference Books:

1. Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Calculus, New Gamma Publishing House, June 2014.
2. Shanthi Narayan, Dr. P. K. Mittal, Differential Calculus, S. Chand Publishing Company Ltd., 2005.

Paper 2 - THEORY OF EQUATIONS AND TRIGONOMETRY

Objectives:

1. **To solve cubic and biquadratic equations**
2. **To find logarithm of complex numbers**

UNIT I

Introduction about polynomials, equations - Remainder theorem - Imaginary roots - Irrational roots - Relation between roots and coefficients of equations - Symmetric functions of the roots - Sum of powers of roots of an equation - Newton's Theorem.

UNIT II

Transformations of equations - Roots with signs changed - Roots multiplied by a given number - Reciprocal roots - Reciprocal equation - Increase and decrease the roots of a given equation by a given quantity - Removal of terms – Equations whose roots are any power of the roots of a given equation.

UNIT III

Descarte's rule - Rolle's theorem - Multiple roots - Strum's theorem - Newton's method of divisors - Horner's method.

UNIT IV

General solution of cubic equations - Cardon's Method - Ferrari's method of solving biquadratic equations - Expansion of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ - Examples on formation of equations - Expansion of $\sin^n\theta \cos^n\theta$, $\sin^n\theta \cos^m\theta$**.**

UNIT V

Expansion of $\sin\theta$, $\cos\theta$, $\tan\theta$ in powers of θ – Hyperbolic functions - Relation between hyperbolic functions - Inverse hyperbolic functions - Logarithm of complex quantities.

Text Books:

1. T. K. M. Pillai, T. Narayanan and K. S. Ganapathy, Algebra, Volume I, S. Viswanathan Publishing Company, 2012.
2. T. K. M. Pillai and S. Narayanan, Trigonometry, S. Viswanathan Publishing Company, 2009.

Reference Books:

1. Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Classical Algebra Theory of Equations, New Gamma Publishing House, July 2016.
2. Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Trigonometry, New Gamma Publishing House, November 2017.
3. Hari kishan, Theory of equations, Atlantic publishers and Distributers Pvt Ltd, December 2013.

Paper 3 - DIFFERENTIAL EQUATIONS

Objectives:

1. **To solve linear equations with variable coefficients**
2. **To study partial differential equations**
3. **To know the applications in real life.**

UNIT I

Exact differential equations – Integrating Factors – Linear Equations – Bernoulli's Equations - Equations of the first order and higher degree - Linear equations with constant co-efficients – Methods of finding complementary functions – Methods of finding particular integrals.

UNIT II

Homogenous linear equations - Linear equations with variable co-efficients - Simultaneous linear equations - Total differential equations.

UNIT III

Formations of partial differential equations – First order partial differentaial equations – Methods of solving first order PDE – Some standard forms.

UNIT IV

Charpit's Method - PDE. of the higher order – Homogenous differential equations.

UNIT V

Orthogonal trajectories - Growth and decay - Continuous compound interest - The Braachistochrone Problem - Simple electric circuit - Falling bodies - SHM - Simple pendulum - Central forces - Planatary motion - Dynamical problems with variable mass.

Text Book:

Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Differential Equations and Applications, New Gamma Publishing House, July 2014.

Unit I: Chapter 1 – Sections 3, 4, 5, 6, 7, Chapter 2 – Sections 1, 2 and 3
Unit II: Chapter 2 - Sections 4, 5, 6, 7
Unit III: Chapter 4 - Sections 1, 2, 3 and 4.
Unit IV: Chapter 4 – Sections 5, Chapter 5 – Sections 1 and 2.
Unit V: Chapter 6 (Except Section 5).

Reference Books:

1. T. K. M. Pillai and S. Narayanan, Calculus, Volume III, S. Viswanathan Publishing Company, 2012.
2. N. P. Bali, Golden Differential Equations, Laxmi Publications, 2006.

Paper 4 - ANALYTICAL GEOMETRY OF 3D AND VECTOR CALCULUS

Objectives:

1. **To know about 3-Dimensions**
2. **To study vector differentiation and vector integration.**

UNIT I

Angle between two planes - Length of perpendicular - Bisector - Distance between two planes.

UNIT II

Equations of the straight line – A plane and a line.

UNIT III

Sphere – Equation of a sphere – Tangent line - Tangent plane – Sections of the sphere.

UNIT IV

Vector differentiation: Vector algebra – Differentiation of vectors – Gradient - Divergents and Curl.

UNIT V

Vector integration: Line integrals - Surface integral – Problems on Theorems of Green, Gauss and Stoke's.

Text Book:

Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Analytical Geometry of 3D and Vector Calculus, New Gamma Publishing House, January 2017.
Unit I: Chapter 2 - Sections 2.1, 2.2, 2.3
Unit II: Chapter 3 - Sections 3.1, 3.2
Unit III: Chapter 4 - Sections 4.1, 4.2, 4.3.
Unit IV: Chapter 5 - Sections 5.1, 5.2, 5.3, 5.4
Unit V: Chapter 7 – Sections 7.1, 7.2, 7.3

Reference Books:

1. T. K. M. Pillai and S. Narayanan, Analytical Geometry, S. Viswanathan Publishing Company, 2012.
2. P. Durai pandian and others, Analytical Geometry 3-Dimension, Emerald Publishers, 1998.

Paper 5 – MECHANICS

Objectives:

1. **To provide the basic knowledge of equilibrium of a particle**
2. **To provide the basic knowledge of moving particle.**

UNIT I

Forces acting at a point - Resultant and components - Parallelogram law of forces - Triangle law of forces - lami's Theorem - Resolution of a forces - Theorem of resolved parts - Resultant of any number of coplanar forces - condition of equilibrium.

UNIT II

Forces acting on a rigid body - Parallel forces - Resultanat of two like and unlike parallel forces - Moment of a forces - Varignon's Theorem - Three forces acting on a rrigid body - law of friction - coefficient of friction - angle of friction - cone of friction - problem.

UNIT III

Projectiles - shape of projectile - range of projectile - inclined plane.

UNIT IV

Impact - Impluses - impact in a fired plane - Direct and oblique impact.

UNIT V

Central orbit - components of velocity and acceleration along and perpendicular to radius vector - differential equation ofn central orbit - pedal equation.

Text Books:

1. M. K. Venkataraman, Statics, Agasthiar Publications, 17th Edition, July 2014.
2. M. K. Venkataraman, Dynamics, Agasthiar Publications, 16th Edition, January 2014.

Reference Books:

1. P. Durai Pandian and others, Mechanics, S. Chand Publishing Company, 1997.
2. Dr. M. D. Raisingharia, Dynamics, S. Chand Company, 2006.

Paper 6 – BASICS OF ANALYSIS

Objectives:

1. **To understand the countable concepts in real number system**
2. **To study the behavior of sequences and series**
3. **To provide a good foundation for real analysis.**

UNIT I

Sets and elements - Operations on sets - Functions - Real-valued functions - Equivalence - Countability - Real numbers - Least upper bounds.

UNIT II

Definition of sequences - Limit of a sequence - Convergent sequences - Divergent sequences - Bounded sequences - Monotone sequences.

UNIT III

Limit superior and limit inferior - Cauchy sequences - Convergence and Divergence - Series with nonnegative terms - Alternating series - Conditional convergence and absolute convergence.

UNIT IV

Rearrangement of a series - Test for absolute convergence - Series whose term form a non-increasing sequence – Summation by parts - The class I^2.

UNIT V

Limit of function on the real line - Metric spaces - Limits in Metric spaces.

Text Book:

Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2017.
Unit I: Chapter 1
Unit II: Chapter 2 – Sections 1, 2, 3, 4, 5 and 6
Unit III: Chapter 2 – Sections 9 and 10, Chapter 3 – Sections 1, 2, 3 and 4
Unit IV: Chapter 3 – Sections 5, 6, 7, 8 and 10.
Unit V: Chapter 4 – Sections 1, 2 and 3

Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill International Editions, Singapore, Reprint 2012.
2. Tom M. Apostol, Mathematical Analysis, 2nd Edition, Pearson, Narosa Publishing House, New Delhi, 2002.

Paper 7 – MODERN ALGEBRA

Objectives:

1. **To learn a method to count the elements of a finite group.**
2. **To construct a quotient groups using an integral domain.**

UNIT I

Groups: Definition – Examples, Properties (Statement only) – Permutation groups – Subgroups – Cyclic groups – Order of an element.

UNIT II

Cosets and Lagrange's theorem - Normal subgroups and Quotient groups.

UNIT III

Isomorphism – Homomorphism.

UNIT IV

Rings: Definition and Examples- Elementary properties of rings – Isomorphism – Types of rings - Characteristic of a ring - Subrings.

UNIT V

Ideals – Quotient rings – Maximal and prime ideals – Homomorphism of rings – Field of quotients of an integral domain.

Text Book:

Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Modern Algebra, SciTech Publication, India Private Ltd., January 2018.
Unit I: Chapter 3 – Sections 1, 4, 5, 6 and 7.
Unit II: Chapter 3 – Sections 8 and 9.
Unit III: Chapter 3 - Sections 10 and 11.
Unit IV: Chapter 4 – Sections 1, 2, 3, 4, 5 and 6
Unit V: Chapter 4 – Sections 7, 8, 9, 10 and 11.

Reference Books:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, 2006.
2. A. R. Vasishtha, Modern Algebra, Krishna Publication, January 2015.

Paper 8 - REAL ANALYSIS

Objectives:

1. **To analyze the real line structure.**
2. **To study properties of the Riemann integral.**

UNIT I

Continuous functions on Metric spaces - Functions continuous at a point on the real line - Reformulation - Functions continuous on a metric space - Open sets - Closed sets - Discontinuous functions on R^1.

UNIT II

Connectedness - Completeness - More about open sets - Connected sets - Bounded sets and totally bounded sets - Complete metric spaces.

UNIT III

Compactness - Compact metric spaces - Continuous functions on compact metric spaces - Continuity of the inverse function - Uniform continuity.

UNIT IV

Sets of measure zero - Definition of the Riemann integral - Existence of the Riemann integral – Properties of the Riemann integral.

UNIT V

Derivatives - Rolle's theorem - The law of the mean - Fundamental theorem of calculus.

Text Book:

Richard R Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2017.
Unit I: Chapter 5
Unit II: Chapter 6 – Sections 1, 2, 3 and 4
Unit III: Chapter 6 – Sections 5, 6, 7 and 8
Unit IV: Chapter 7 – Sections 1, 2, 3 and 4
Unit V: Chapter 7 – Sections 5, 6, 7 and 8.

Reference Books:

1. Walter Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw-Hill International Editions, Singapore, Reprint 2012.
2. Tom M. Apostol, Mathematical Analysis, 2nd Edition, Pearson, Narosa Publishing House, New Delhi, 2002.

Paper 9 – FUNDAMENTALS OF STATISTICS

Objectives:

1. **To analyze the data.**
2. **To analyze the qualitative characteristics – Attributes.**

UNIT I

Measure of Central tendency - Measures of Dispersion - Moments - Measures of Skewness - Measures of Kurtosis - Theorems with proof and related problems.

UNIT II

Correlation - Rank Correlation - Regression - Regression line of x on y and Regression line of y on x - Theorems with proof and related problems.

UNIT III

Index Numbers - Consumer Price Index numbers - Conversion of Chain Base Index Number into Fixed base index numbers - Related Problems.

UNIT IV

Curve Fitting - Principle of Least Squares - Fitting a straight line - Fitting a second degree parabola - Fitting of power curves - Related Problems.

UNIT V

Theory of Attributes - Attributes - Consistency of Data - Independence and Associate of Data - Related Problems.

Text Book:

Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Statistics, New Gamma Publishing House, July 2016.

Unit I: Chapter 2, 3, 4
Unit II: Chapter 6
Unit III: Chapter 9
Unit IV: Chapter 5
Unit V: Chapter 8

Reference Books:

1. T. Veerarajan, Fundamentals of Mathematical Statistics, YesDee Publishing Private Ltd, 2017.
2. B. L. Agarwal, Basic Statistics, New Age International Publishers, 6th Edition.

Paper 10 - OPERATIONS RESEARCH

Objectives:

1. **To find an optimal solution to the problem.**
2. **To study in what order we have to do the jobs.**
3. **To study at what time we have to replace a machine.**

UNIT I

Linear Programming problem - Formulation of LPP Mathematical form - Solution of LPP - Graphical Method - Simplex method.

UNIT II

Two-Phase method – Duality - Axioms of duality theory - Dual simplex method.

UNIT III

Transportation problem - Mathematical form - Initial solutions by Northwest corner rule - Maxima and Minima method - Vogel's approximation method - Optimality test by Modi method for both balanced and unbalanced T.P - Assignment Problem - Hungarian method.

UNIT IV

Game theory - Two person zero sum game - Maximin and minimax principle of optimality - Saddle point - Solution of the game using formula - Graphical solution of (2 x n) and (m x 2) games - LPP method.

UNIT V

Sequencing - Optimal sequencing algorithms - Replacement problems.

Text Book:

T. Veerarajan, Operations Research, Universities Press, 2017.
Unit I: Chapter 1
Unit II: Chapter 2 and Chapter 4.
Unit III: Chapter 8
Unit IV: Chapter 10
Unit V: Chapter 9 and 12.

Reference Books:

1. Dr. S. Arumugam and Prof. Thangapandi Issac, Linear Programming, New Gamma Publishing House, March 2015.
2. Kanti Swarup, P. K. Gupta, Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, 1978.

Paper 11 - LINEAR ALGEBRA

Objectives:

1. **To introduce another algebraic system known as vector space.**
2. **To know Eigen values and Eigen vectors.**

UNIT I

Vector spaces: Definitions and Examples – Subspaces – Linear Transformations - Span of a set.

UNIT II

Linear independence – Basis and dimensions – Rank and Nullity – Matrix of a linear transformation.

UNIT III

Inner product Spaces: Definition and examples – Orthogonality – Orthogonal Complement.

UNIT IV

Matrices – Elementary transformations – Rank of a matrix – Simultaneous linear equations – Characteristic equations and Cayley Hamilton theorem – Eigen values and eigen vectors.

UNIT V

Bilinear forms – Quadratic forms.

Text Book:

Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Modern Algebra, SciTech Publication, India Private Ltd., January 2018.
Unit I: Chapter 5 – Sections 1, 2, 3 and 4
Unit II: Chapter 5 – Sections 5, 6, 7 and 8
Unit III: Chapter 6 – Sections 1, 2 and 3
Unit IV: Chapter 7 – Sections 4, 5, 6, 7 and 8
Unit V: Chapter 8 – Sections 1 and 2.

Reference Books:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, 2006.
2. A. R. Vasishtha, Modern Algebra, Krishna Publication, January 2015.

Paper 12 – COMPLEX ANALYSIS

Objectives:

1. **To study the differentiation of a complex valued function of a complex variable.**
2. **To study the integration of a complex valued function of a complex variable.**

UNIT I

Analytic functions: Functions of a complex variable – Limits – Theorems on limit – Continuous functions – Differentiability – The Cauchy Riemann equations - Analytic Functions – Conformal mapping.

UNIT II

Bilinear transformations: Elementary transformations – Bilinear transformations – Cross ratio – Fixed points of bilinear transformations – Some special bilinear transformations.

UNIT III

Complex Integration: Definite integral – Cauchy's theorem – Cauchy's integral formula – Higher derivatives.

UNIT IV

Series expansions – Taylor's series – Laurent's series – Zeros of an analytic function – Singularities.

UNIT V

Calculus of residues: Residues – Calculus – Residue theorem.

Text Book:

Dr. S. Arumugam, Prof. A. Thangapandi Isaac and Dr. A. Somasundaram, Complex Analysis, SciTech Publication, India Private Ltd., January 2018.
Unit I: Chapter 2
Unit II: Chapter 3
Unit III: Chapter 6
Unit IV: Chapter 7
Unit V: Chapter 8 – Sections 1 and 2.

Reference Books:

1. P. Durai Pandian and Others, Complex Analysis, S. Chand Publishing Company, 2014.
2. Dr. R. Roopkumar, Complex Analysis, Pearson Education India, 2014.
3. T. K. M. Pillai, Dr. S. P. Rajagopalan and Dr. R. Sattanathan, Complex Analysis, S. Vishwanathan Private Ltd., 2009.

Paper 13 - STATISTICS

Objectives:

1. **To know probability and distribution functions**
2. **To study the tests of significance**

UNIT I

Theory of Probability - Sample Space - Probability function - Laws of Addition - Conditional Probability - Law of multiplication - Independent - Boole's inequality - Baye's Theorem - Theorems with proof and related problems.

UNIT II

Random Variables - Distribution function - Discrete and Continuous random variables - Probability density function - Mathematical Expectation (One dimensional only).

UNIT III

Moment generating function - Cumulates - Characteristic function - Theoretical Distribution - Binomial -n Poisson - Normal - Theorems with proof and related problems.

UNIT IV

Test of Significance of Large samples.

UNIT V

Test of significance of small samples - t-f-Chi square

Text Book:

Dr.S. Arumugam, A. Thangapandi Isaac, Statistics, New Gamma Publishing House, July 2016.
Unit I: Chapter 11
Unit II: Chapter 12 Sections 1, 2, 3 and 4.
Unit III: Chapter 12 Sections 5 and 6, Chapter 13
Unit IV: Chapter 14
Unit V: Chapter 15, 16

Reference Books:

1. T. Veerarajan, Fundamentals of Mathematical Statistics, YesDee Publishing Private Ltd, 2017.
2. B. L. Agarwal, Basic Statistics, New Age International Publishers, 6th Edition.

Paper 14 – ELECTIVE
Any one of the following subjects.

1. Fuzzy sets and Fuzzy logic
2. Mathematical Modeling
3. Number Theory

FUZZY SETS AND FUZZY LOGIC

Objectives:

1. To enable the students understand the need of fuzzy sets
2. To make the learners attain comprehensive acquisition of fuzzy operations and relations
3. To assist the stake holders in acquisition of the applications of fuzzy logic in real life situations

UNIT I

Crisp set – operations on crisp sets – Fuzzy sets – representation of a fuzzy set – representation of membership function – types of fuzzy sets –cut of a fuzzy set - α-cut decomposition – some more definitions

UNIT II

Operations on fuzzy sets– properties of operation on fuzzy sets – first and second decomposition theorems - product on fuzzy sets

UNIT III

Fuzzy numbers – linguistic variables – fuzzy arithmetic – properties on interval valued arithmetic operations –operations on fuzzy numbers – fuzzyequations – latticeof fuzzy numbers

UNIT IV

Classical logic –logical connectives – truth values and truth tables – fuzzy logic – fuzzy logic truth tables – fuzzy connectives

UNIT V

Relation on fuzzy sets–representation – composition of fuzzy relations – max-min composition properties – fuzzy equivalence relation.

Text Book:

D S Hooda and Vivek Raich, Fuzzy Set Theory and Fuzzy Control, Narosa Publishing
House, New Delhi, 2015.
Unit I: Chapter 1 Sections 1 to 5
Unit II: Chapter 1 Sections 6 to 8
Unit III: Chapter 2
Unit IV: Chapter 3 Sections 1 to 4 and 7 to 9
Unit V: Chapter 4 Sections 1 to 4

Reference Books:

1. George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic Theory and Applications, PHI Learning Private Limited, New Delhi, 2009.
2. Zimmermann, Fuzzy set theory and its applications, Affiliated East West Press Pvt Ltd, 2nd Edition, 1996.
3. M. Murugalingam and Others, Introduction to Fuzzy Algebra, Sivam Publications, Vikramasingapuram, 2006.

MATHEMATICAL MODELLING

Objectives:

1. To enable the students to learn mathematical concepts.
2. To built mathematical models of real world problems and find solutions to these models.

UNIT I

Mathematical modeling – Need – Techniques and Classifications - Characteristics of mathematical model – Mathematical modeling through geometry, algebra, trigonometry and calculus – Limitations of mathematical modeling.

UNIT II

Mathematical modeling through ordinary differential equations of first order- Linear and non-linear growth and decay models - Compartment models – Mathematical modeling in dynamics- Mathematical modeling of geometrical problems.

UNIT III

Mathematical modeling through system ordinary differential equations of first order – Mathematical modeling in population dynamics – Mathematical modeling in economics – Mathematical models in medicine – Mathematical modeling in dynamics through system of ordinary differential equations of first order.

UNIT IV

Mathematical modeling through ordinary differential equations of second order – Mathematical modeling of planetary motions – Mathematical modeling of circular motions – Motion of satellite.

UNIT V

Mathematical Modeling through graphs - Mathematical Models in terms of directed graphs - Mathematical models in terms of signed graphs - Mathematical models in terms of weighted graphs.

Text Book:

Kapur J N, Mathematical Modeling, II Edition, New Age International Publishers, New Delhi, Reprint – 2018.
Unit I: Chapter 1 - Sections 1 to 9.
Unit II: Chapter 2 – Sections 1 to 6.
Unit III: Chapter 3 – Sections 1, 4, 5 and 6.
Unit IV: Chapter 4 – Sections 1 and 2.
Unit V: Chapter 7 – Sections 1 to 4.

Reference Books:

1. Frank R. Giordano, William P. Fox, Steven B. Horton, A First Course in Mathematical Modeling, V Edition, Cengage Learning, 2015.
2. Reinhard Illner, Mathematical Modeling, AMS Publications, 2016.

NUMBER THEORY

Objectives:

1. To provide a deep knowledge of number theory as this is one of the pillars of mathematics.
2. To know the applications of Wilson's theorem, Wolsten hold theorem.

UNIT I

Introduction: Divisibility, Prime and composite numbers - Congruences: Definition – Residue classes – Complete and least residue system – Reduced residue system – Casting out 9 – Magic numbers – Divisibility test.

UNIT II

Linear Congruences - Solution of congruences - Chinese remainder theorem – Little Fermat's theorem – Euler's theorem.

UNIT III

Inverse modulo – Wilson's theorem and its converse – Lagrange's theorem – Wolsten hold theorem – Factor theorem for polynomials – Number of solutions.

UNIT IV

Congruences of prime power modulli – Composite modulli – Identical congruences – Multiple roots of congruences.

UNIT V

Quadratic residues and non-residues – Euler's criterion – primitive root is a quadratic non-residue – Legendre's symbol.

Text Book:

Kumaravelu and Suseela Kumaravelu, Elements of Number Theory, SKV Publications, 2002.

Reference Books:

1. Ivan Niven, Herbert S. Zuckarman and Hugh L. Montgometry, An Introduction to the Theory of Numbers, 5th Edition, John Wiley and sons, Inc., 2001.
2. V. K. Krishnan, Elementary Number Theory, Universities Press, 2017.

ALLIED SUBJECT II
(APPLICATIONS OF MATHEMATICS)
PAPER 1 – PROGRAMMING IN C

Objectives:

1. To learn a computer language.
2. To write programs and run programs.

UNIT I

Introduction - Importance of C - Programming style-character set - C Tokens-keywords and identifiers – Constants – Variables - Data types - Declaration of variables - Declaration of storage class-assigning values to variables-defining symbolic constants.

UNIT II

Operators and expressions-arithmetic, relational, logical, assignment, increment and decrement, bitwise, conditional, special operators-arithmetic expressions-evaluation of expressions-precedence of arithmetic expressions.

UNIT III

Managing input and output operations-reading a character-writing a character-formatted input-formatted output-decision making with if - simple if, if else, nesting of if else, else if, switch, goto, while do while, for statements-jumps in loops.

UNIT IV

Arrays-one dimensional arrays-declaration of one dimensional arrays-initialization of one dimensional arrays-two dimensional arrays initializing two dimensional arrays-multi dimensional arrays-dynamic arrays.

UNIT V

Structure definition-declaring structure variables-accessing structure members- structure initialization-pointer expressions-pointer increment and scale factor- pointer and arrays-array of pointers-pointers as function arguments-functions returning pointer- pointers to functions.

Text Book:

E. Balagurusamy, Programming in ANSI C, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

Reference Books:

1. Byron S. Gottfried, Schaum's Outline of Programming with C, 2nd Edition.
2. Darrel L. Graham, C Programming Language, Createspace Independent Publishing Company, 2016.

Paper 2 – PROGRAMMING WITH C++

Objectives:

1. **To write a program efficiently.**
2. **To know OOPS.**

UNIT I

Principles of object oriented programming - basic concepts of oops- benefits-introduction to C++ - token - keywords - identifiers and constants - data types -symbolic constants-operators-expressions and control structures.

UNIT II

Functions - function prototyping - call by reference - return by reference –inline functions-default arguments-constant arguments-function overloading -friend and virtual functions-Math library functions.

UNIT III

Classes and objects - arrays within a class - memory allocation for objects - static data members, functions-arrays of objects - friendly functions - returning objects - pointers to members-local classes.

UNIT IV

Constructors- parameterized, multiple constructor- copy constructor - dynamic constructors -constructing two dimensional arrays- destructors.

UNIT V

Operator overloading - overloading unary operators - overloading binary operators - rules for overloading operators - defining derived classes - inheritance and their types.

Text Book:

E Balagurusamy , Object-Oriented Programming with C++, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

Reference Books:

1. Byron S. Gottfried, Schaum's Outline of Programming with C++, 2nd Edition.
2. Richard Grimes, Beginning C++ Programming, Packt Publishing Limited, 2017.

Paper 3 - GRAPH THEORY

Objectives:

1. To give a basic knowledge in graph theory
2. To study Eulerian graphs, Hamiltonian graphs, Trees.

UNIT I
Graphs - Subgraphs - Isomorphism and degrees - Walks and connected graphs - Cycles in graphs - Cut vertices and cut edges.

UNIT II
Eluerain graphs - Fleury's algorithm - Hamiltonian graphs - Weighted graphs.

UNIT III
Bipartite graphs - Marriage problem - Trees - Connector problem.

UNIT IV
Matrix representations - Planar graphs - Euler formula - Platonic solids - Dual of a plane graph - Characterization of planar graphs.

UNIT V
Vertex colouring - Edge colouring - An algorithm for vertex colouring – Directed graphs.

Text Book:

S. A. Choudum, A First course in Graph Theory, Macmillan Publishers India Pvt Ltd, 2000.

Unit I: Chapter 1
Unit II: Chapter 2
Unit III: Chapter 3
Unit IV: Chapter 4 – Section 1 and Chapter 5.
Unit V: Chapter 6 and Chapter 7 – Section 1

Reference Book:

1. F. Harary, Graph Theory, Narosa Publishing Company, 2001.
2. J. Clark and D. A. Holton, A First Look at Graph Theory, Allied Publishers, New Delhi, 2005.

Paper 4 - NUMERICAL ANALYSIS

Objectives:

1. To know algebraic, trancedental and simultaneous equations.
2. To study about finite differences, interpolation, attributes, etc.

UNIT I

Algebraic and Transcendental equations – Errors in numeric computations – Iteration method – Aitken's Δ^2 Method – Bisection method – Regula-falsi method – Newton's Raphson method .

UNIT II

Simultaneous equations: Back substitution – Gauss elimination method – Gauss Jordan method – Calculation of inverse of a matrix – Gauss Jacobi iteration method – Gauss Seidal iteration method.

UNIT III

Finite differences – Difference operators – Other difference operators - Difference equations – Formation of difference equations – Linear difference equations.

UNIT IV

Interpolation: Newton's interpolation formula – Central difference interpolation formulae – Lagrange's interpolation formulae – Divided difference formula – Inverse interpolation.

UNIT V

Numerical differentiation – Derivatives using Newton's forward difference formula – Derivatives using Newton's backward difference formula - Derivatives using Newton's central difference formula – Maxima and minima of the interpolating polynomial – Attributes.

Text Book:

Dr. S. Arumugam, Prof. A. Thangapandi Isaac and Dr. A. Somasundaram, Numerical Analysis with Programming in C, New Gamma Publishing House, June 2015.

Unit I: Chapter 1

Unit II: Chapter 2

Unit III: Chapter 3

Unit IV: Chapter 4

Unit V: Chapter 5 and Chapter 8 – Section 1

Reference Books:

1. T. Veerarajan and T. Ramachandran, Numerical Methods with Programming in C, McGraw Hill Education, 2008.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt Ltd., New Delhi, 2012.

PART IV – SKILL BASED SUBJECTS

Paper 1 - FOURIER SERIES AND LAPLACE TRANSFORMS

Objectives:

1. To discuss the basic concepts relating Fourier series
2. To solve certain types of differential equations using Laplace transforms.

UNIT I

Fourier series - Periodic functions - Fourier series full range.

UNIT II

Fourier series half range – Fourier series arbitrary range.

UNIT III

Laplace transforms.

UNIT IV

Inverse Laplace transforms.

UNIT V

Solution of differential equations using Laplace transforms.

Text Book:

Dr. S. Arumugam, Prof. A. Thangapandi Isaac, Trigonometry, Fourier series and Laplace Transform, New Gamma Publishing House, November 2017.
Unit I: Chapter 2 – Sections 1 and 2
Unit II: Chapter 2 – Sections 3 and 4
Unit III: Chapter 3 – Section 1
Unit IV: Chapter 3 – Section 2
Unit V: Chapter 3 – Section 3

Reference Book:

S. Narayanan and T. K. Manickavasagam Pillai, Differential Equations and its applications, S. Viswanathan Publishing Company, Chennai, 2012.

Paper 2 – ENVIRONMENTAL STUDIES
(Syllabus Common to All Undergraduate Courses)

Paper 3 – LOGIC AND BOOLEAN ALGEBRA

Objectives:

1. To understand the logical concepts which are needed in mathematics.
2. To learn about Boolean algebra.

UNIT I

Propositional calculus - Statements - Basic operations - Truth value of compound statements - Propositions and truth tables.

UNIT II

Tautologies and contradictions - Logical equivalences - Negation - De Morgon's laws - Algebra of propositions - Conditional propositions.

UNIT III

Bicondition arguments - Arguments and statements - Logical implication - Quantifiers.

UNIT IV

Boolean algebra - Logic gates - Basic definitions and theorems - Order and Boolean algebras - Boolean expressions - Sum of products form.

UNIT V

Logic gates - Logic circuits - Minimal Boolean expressions - Prime implicants - Farnaugh maps - Minimal AND - OR circuits.

Text Book:

Seymar Lipschutz, Marcs Lars Lipson, Discrete Mathematics, Schaum's Series, McGraw Hill, International Edition, 2010.

Reference Books:

1. S. Santha, Discrete Mathematics, Cengage Learning, 2012.
2. Ralph P. Grimaldi, B. V. Ramana, Discrete and Combinatorial Mathematics, Pearson India Education Services Pvt Ltd., 2016.

Paper 4 – VALUE EDUCATION

(Syllabus Common to All Undergraduate Courses)

NON-MAJOR ELECTIVE
FUNDAMENTALS OF MATHEMATICS

Objectives:

1. To introduce important elementary concepts of mathematics for non-mathematics students

2. To develop computational skills

UNIT I

Numbers: Operations on numbers, Tests of divisibility.

UNIT II

Simplifications: BODMAS Rule, Modulus of a real number, Virnaculum.

UNIT III

Problems on Numbers, Problems on Ages.

UNIT IV

Percentage: Concept of percentage, Results on population, Results on depreciation.

UNIT V

Profit and Loss: Cost price, Selling price, Profit or gain, Loss.

Text Book:

R.S. Aggarwal, Quantitative Aptitude, S. Chand and Company Ltd., New Delhi, 2017.

Reference Books:

1. Dr.M.Manoharan, Dr.C.Elango and Prof K.L.Eswaran, Business Mathematics, Palani paramount Publications, Reprint 2013.
2. G. K. Ranganath, C. S. Sampangiram, Y. Rajaram, Text Book of Business Mathematics, Himalaya Publishing House, 2017.

QUANTITATIVE APTITUDE

Objectives:

1. **To impart the Aptitude knowledge required for Competitive Examinations.**

UNIT I

Ratio and Proportion: Ratio, Proportion, Fourth proportional, Third proportional, Mean proportional, Comparison of ratios, Compounded ratios, Duplicate ratio, Sub Duplicate ratio, Triplicate ratio, Sub triplicate ratio. Componendo and dividendo, Variation.

UNIT II

Partnership: Partnership, Ratio of division of gains. Working and sleeping partners.

UNIT III

Time and Work & Time and Distance.

UNIT IV

Simple Interest: Principal, Interest, Simple interest.

UNIT V

Compound Interest: Compounded annualy, Half yearly, Quarterly. Rates are different for different years.

Text Book:

R.S. Aggarwal, Quantitative Aptitude, S. Chand and Company Ltd., New Delhi, 2017.

Reference Books:

1. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications, 2016.
2. Dr.M.Manoharan, Dr.C.Elango and Prof K.L.Eswaran, Business Mathematics, Palani paramount Publications, Reprint 2013.

ALLIED MATHEMATICS
(For B. Sc Physics and B. Sc Chemistry Courses)

ANCILLARY MATHEMATICS I

Objectives:

1. To learn the applications of differentiation.
2. To solve differential equations
3. To learn partial differential equations
4. To know the applications of differential equations.

UNIT I

Differentiation: n^{th} – derivatives and Leibnitz Theorem. Curvature – Center of Curvature - Radius of curvature – Circle of curvature.

UNIT II

Integration: Reduction formula – Double integrals - Evaluation of Double Integrals – Triple integrals.

UNIT III

Equations of the first order and higher degree - Linear equations with constant co-efficients – Methods of finding complementary functions – Methods of finding particular integrals.

UNIT IV

Formations of partial differential equations – First order partial differential equations – Methods of solving first order PDE – Some standard forms.

UNIT V

Orthogonal trajectories - Growth and decay - Continuous compound interest - The Braachistochrone Problem - Simple electric circuit - Falling bodies - SHM - Simple pendulum

Text Books:

1. Dr. S. Arumugam & Issac, Calculus, New Gamma Publishing House, June 2014.
2. Dr. S. Arumugam & Isaac, Differential Equations and Applications, New Gamma Publishing House, July 2014.

Reference Books:

1. T. K. M. Pillai and S. Narayanan, Calculus, Volume III, S. Viswanathan Publishing Company, 2012.
2. Shanthi Narayan, Dr. P. K. Mittal, Differential Calculus, S. Chand Publishing Company Ltd., 2005.

ANCILLARY MATHEMATICS II

Objectives:

1. To explore trigonometry as a tool in solving problems.
2. To learn vector differentiation and vector integration.

UNIT I

Relation between roots and coefficients - Matrices: Characteristic Equation of a Matrix – Eigen Values and Eigen Vectors.

UNIT II

Trigonometry: Hyperbolic functions – Inverse hyperbolic Functions – Logarithm of Complex numbers.

UNIT III

Sphere – Standard equation – Tangent Line and Tangent Plane – Section of a Sphere.

UNIT IV

Vector Differentiation – Gradient – Divergence - Curl and their Properties – Solenoidal - Irrotational Vectors - Directional Derivative.

UNIT V

Vector Integration – Line Integrals – Surface Integrals.

Text Books:

1. S. Arumugam & Issac,Trigonometry, New Gamma Publishing House, November 2017.
2. S. Arumugam & Issac, Analytical Geometry 3D and Vector Calculus, New Gamma Publishing House, January 2017.

Reference Books:

1. T. K. M. Pillai and S. Narayanan, Analytical Geometry, S. Viswanathan Publishing Company, 2012.
2. P. Durai pandian and others, Analytical Geometry 3-Dimension, Emerald Publishers, 1998.

ANCILLARY MATHEMATICS III

Objectives:

1. To know the need and importance of statistical analysis in their major subjects

UNIT I

Moments - Measures of Skewness – Karl Pearson's Coefficient of Skewness – Bowley's Coefficient of Skewness – Measures of Kurtosis.

UNIT II

Correlation – Rank correlation – Regression.

UNIT III

Interpolation – Finite differences – Newton's Formula (Problems only) – Lagrange's formula (Problems only).

UNIT IV

Theory of attributes: Consistency of a data.

UNIT V

Index numbers – Consumer index numbers – Conversion of chain base index number to the fixed base index number and conversely.

Text Book:

Dr. S. Arumugam and Prof. Thangapandi Issac, Statistics, New Gamma Publishing House, July 2016.

Reference Books:

1. T. Veerarajan, Fundamentals of Mathematical Statistics, YesDee Publishing Private Ltd, 2017.
2. B. L. Agarwal, Basic Statistics, New Age International Publishers, 6th Edition.

ANCILLARY MATHEMATICS - IV

Objectives:

1. To introduce the fundamental concepts of LPP.
2. To develop the skills in decision making
3. To equip the students in solving real time problems.

UNIT I

Linear Programming Problems: Formulation of LPP – Mathematical formulation of LPP – Solution of LPP – Graphical Method.

UNIT II

Simplex Method – Big-M method.

UNIT III

Duality in LPP.

UNIT IV

Transportation Problem: Mathematical formulation TP – Degeneracy of TP

UNIT V

Assignment Problems: Mathematical formulation of AP – Solution to AP – Sequencing: Processing n jobs in two machines – Processing n jobs in m machines.

Text Book:

Dr. S. Arumugam and Prof. Thangapandi Issac, Linear Programming, New Gamma Publishing House, March 2015.
Unit I: Chapter 3 – Sections 1, 2, 3 and 4
Unit II: Chapter 3 - Sections 5 and 6
Unit III: Chapter 3 - Section 9
Unit IV: Chapter 4
Unit V: Chapter 5 and Chapter 6 - Sections 1 and 2.

Reference Books:

1. Dr. S. Arumugam and Prof. Thangapandi Issac, Linear Programming, New Gamma Publishing House, March 2015.
2. Kanti Swarup, P. K. Gupta, Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, 1978.

MODEL QUESTION

Subject Code **Month and Year**

MODERN ALGEBRA

Maximum: 75 Marks **Time: 3 Hours**

PART A **(10 X 1 = 10 marks)**

Answer ALL Questions.
Choose the Correct Answer:

1. The number of elements in Symmetric group S_n is -----
   (a) n! (b) n (c) n^2 (d) n^3

2. In the group G = {1, i, -1, -i}, the generator of G is ------
   (a) i (b) 1 (c) -1 (d) 4
3. The index of (5Z, +) in (Z, +) is ------
   (a) 5 (b) 1 (c) -5 (d) 4

4. [G : H] = ---------
   (a) |G|/|H| (b) |G|.|H| (c) |G| + |H| (d) |G| - |H|

5. Consider (Z, +) and (2Z, +). Let f: Z → 2Z be an isomorphism. Then f(0) = ---
   -
   (a) 0 (b) 2 (c) 1 (d) 5

6. Consider (R, +) and (R^+, .). Let f: R → R^+ be an isomorphism. Then f(0) = ----
   -
   (a) 1 (b) 0 (c) -1 (d) 2

7. A ring R is called a Boolean ring if a^2 = -------, for all a ∈ R.
   (a) a (b) 0 (c) 1 (d) 2

8. In (Z, +, .) ------- and ------ are units.
   (a) 1 and -1 (b) 0 and 1 (c) 0 and -1 (d) 1 and 2

9. The ideal --------- is a prime ideal in Z.
   (a) (3) (b) (4) (c) (6) (d) (9)

10. Let R be any ring. Let a ∈ R. Then aR is a ----------.
    (a) left ideal (b) right ideal (c) ideal (d) integral domain

PART B **(5 X7 = 35 marks)**

Answer ALL Questions.

Choosing either (a) or (b):

11. (a) Prove that any permutation can be expressed as a product of disjoint cycles.

OR

(b) Prove that any subgroup of cyclic group is cyclic.

12. (a) Prove that any two left cosets of a subgroup H of a group G are either identical or disjoint.

OR

(b) Prove that any subgroup H of a group G of index 2 is a normal subgroup.

13. (a) Prove that any infinite cyclic group G is isomorphic to (Z, +).

OR

(b) Prove that any finite cyclic group of order n is isomorphic to $(Z_n , \oplus)$.

14. (a) Prove that Z_n is an integral domain if and only if n is prime.

OR

(b) Prove that any finite commutative ring R without zero divisors is a field.

15. (a) Prove that a field has no proper ideals.

OR

(b) Let R be a commutative ring with identity. Prove that R is a field if and only if R has no proper ideals.

PART C **(3 X10 = 30 marks)**

Answer Any THREE Questions.

16. If a permutation $p \in S_n$ is a product of r transpositions and also a product of s transpositions, prove that either r and s are both even or both odd.
17. State and prove Lagrange's theorem.
18. Prove that isomorphism is an equivalence relation among groups.
19. Prove that the characteristic of any field is either zero or a prime number.
20. Let R be a commutative ring with identity. Prove that an ideal M of R is maximal if and only if R/M is a field.