

SadakathullahAppa College

(Autonomous)

(Reaccredited by NAAC at an 'A' Grade. An ISO 9001:2015 Certified Institution)

Rahmath Nagar, Tirunelveli- 11.

Tamil Nadu.

DEPARTMENT OF MATHEMATICS



Draft CBCS SYLLABUS

For

B.SC MATHEMATICS

(Applicable for students admitted in June 2021 and onwards)

**(Submitted before the <Mathematics> BOS Meeting
to be held on 15-03-2021)**

CBCS SYLLABUS FOR B.Sc Mathematics

COURSE STRUCTURE

(Applicable for students admitted in June 2021 and onwards)

I SEMESTER				II SEMESTER		
Part	COURSE	H/W	C	COURSE	H/W	C
I	Language(T/A) I	6	3	Language(T/A) II	6	3
II	Communicative English I	6	3	Communicative English II	6	3
III	Differential Calculus	5	4	Integral Calculus	5	4
III	Classical Algebra	5	4	Analytical Geometry	5	4
III	Mathematical Statistics-I	6	4	Mathematical Statistics -II	6	4
IV	AECC-I-Value Education-I/II	2	2	AECC-II-Environmental Science	2	2
	TOTAL	30	20	TOTAL	30	20
III SEMESTER				IV SEMESTER		
Part	COURSE	H/W	C	COURSE	H/W	C
I	Language(T/A) III	6	3	Language(T/A) IV	6	3
II	Communicative English III	6	3	Communicative English IV	6	3
III	Real Analysis-I	5	4	Abstract Algebra	5	4
III	Allied-II/1	4	3	Allied-II/2	4	3
III	Allied-II/1P	2	1	Allied-II/2P	2	1
III	SEC-I Common (Introduction to Computers)	2	2	SEC-III (Soft Skills)	2	2
IV	SEC-II(MOOC NPTEL Course)	2	2	Trigonometry	2	2
IV	Mathematics for Competitive Examinations -I	2	2	Mathematics for Competitive Examinations -II	2	2
V				ECA		1
V				SOP		1
IV				Field work/Internship Trg.		2

	Library Reading Hour	1	-		Library Reading Hour	1	-
	TOTAL	30	20		TOTAL	30	24
V SEMESTER					VI SEMESTER		
Part	COURSE	H/W	C		COURSE	H/W	C
III	Linear Algebra	4	4		Complex Analysis	5	4
III	Real Analysis-II	4	4		Graph Theory	5	4
III	Differential Equations	4	4		Numerical Methods	4	4
III	Statics	4	4		Dynamics	4	4
III	Number Theory	4	4				
III	Combinatorial Mathematics	4	4		Operation Research-II (E-Learning –e-pg-padasala)	4	4
	Fuzzy Mathematics				Programming in C –II		
III	Operation Research - 1 (E-Learning – e-pg-padasala)	4	4		DSE IV Project	6+6*	6
	Programming in C-I						
IV	Numerical Ability – I	2	2		Numerical Ability – II	2	2
	TOTAL	30	30		TOTAL	30	28
					NET TOTAL	180 +6*	142

At the end of the IV th semester the students must have to undergo a field work / internship training during the vacation for 6 days (30 hours) to earn 2 credits.

I SEMESTER			
DSC 1	DIFFERENTIAL CALCULUS		
Hrs/Week: 5	Hrs/Sem: 5 x 15 = 75	Hrs./ Unit : 15	Credit:

OBJECTIVES:

1. To impart the basics of differentiation.
2. To apply the differentiation concept to find extrema.
3. To understand the rate of change of direction of the curve with respect to the distance.
4. To understand behavior of curves using asymptotes and to sketch the graphs.
5. To apply the concept of differentiation to solve simultaneous equations using Laplace transformation.

Unit I: Differentiability – Algebra of derivatives - Derivatives of some standard function - hyperbolic function – inverse function - chain rule – substitution method – logarithmic differentiation – parametric method-implicit function – nth derivative.

Unit II: Polar curves – Pedal equation of a curve -Maxima and Minima of functions of two variables

Unit III: Curvature – radius of curvature in Cartesian, parametric and polar coordinates – Evolutes - circle and centre of curvature.

Unit IV: Multiple points-Kinds of cusps - Asymptotes (Excluding Asymptotes of Polar curve).

Unit V: Laplace transform – Inverse Laplace transform- solving linear differential equations & simultaneous equations of first order using Laplace transform.

TEXT BOOK:

1. Calculus by S. Arumugam & Issac , New Gamma Publications -Edition 2005.

2. Differential Equations and Applications by S. Arumugam & Issac, Edition 2011, New gamma Publishing House.

Unit I : TB1: Part I – Chapter II : Section 2.0 – 2.12

Unit II : TB1: Part I - Chapter III : Section 3.2,3.3,3.7

Unit III : TB1:Part I - Chapter III : Section 3.4, 3.5

Unit IV: TB1: Part I – Chapter III: Section 3.10 3.11 (Excluding Asymptotes of Polar curve)

Unit V : TB 2: Chapter III

REFERENCE BOOK:

1. Calculus Volume I by S. Narayanan & T.K. Manicavachagam Pillay, S. ViswanathanPrinters & Publishers Pvt Ltd, Edition 2014.

2. Differential Equation and Vector Calculus by Joseph A. Mangaladoss, Presi-Persi Publications, Edition 2012.

I SEMESTER			
DSC 2	CLASSICAL ALGEBRA		
Hrs/Week: 5	Hrs/Sem: 5 x 15 = 75	Hrs./ Unit : 15	Credit:

OBJECTIVES:

1. To enable the students to understand the transformation of equations.

2. To develop the technique of solving equations of n^{th} degree.

Unit I: Formation of Equations - Division Algorithm – Fundamental theorem of Algebra.

Unit II: Relation between roots and coefficients-Symmetric functions of roots in terms of coefficients.

Unit III: Newton's theorem- Sum of the r^{th} powers of the roots – Descarte's rule of signs-Rolle's Theorem.

Unit IV: Reciprocal equations - Transformation of equations

Unit V: Cardon's method for solution of cubic equation- Ferrari's method for solution of biquadratic equation - Approximate solutions of Equations using Newton Raphson's method and Horner's method

Text Book:

Algebra (Theory of equations, Theory of numbers and Trigonometry) by S.Arumugam & Isaac, New Gamma Publications - Edition 2011.

Unit I: Chapter 5 Section 5.1

Unit II : Chapter 5 – Section 5.2

Unit III: Chapter 5 - Section 5.3, 5.7

Unit IV: Chapter 5 - Section 5.4, 5.5

Unit V : Chapter 5-Section 5.8 – 5.10

REFERENCE BOOK:

Classical Algebra, by Joseph A. Mangaladoss, S. Firthous Fatima, M. Himaya Jaleela Begum and S. Syed Ali Fathima, Presi – Persi Publications – Edition May 2016.

I SEMESTER

MATHEMATICAL STATISTICS I

Hrs / Week : 6

Hrs/ Sem : 6 x 15 = 90

Hrs./ Unit : 18

Credits:4

OBJECTIVES:

1. To introduce various statistical tools to satisfy the need of concept personals.

2. To make the students understand how sampling technique are used in real life problems.

Unit I: Central Tendencies: Introduction – Arithmetic Mean – Partition Values Median, Quartiles, Deciles and Percentiles - Mode - Geometrical mean and Harmonic mean - Measures of dispersion: Range- Quartile deviation- Standard deviation and Mean deviation – Coefficient of variation.

Unit II: Correlation and Regression: Karl Pearson's Coefficient of Correlation – Properties - Rank Correlation- Lines of regression - Regression coefficient and properties.

Unit III: Theory of Attributes: Introduction – Attributes - Consistency of data – Independence and Association of data – Coefficient of association.

Unit IV: Test of significance (Large Samples): Introduction – Sampling - Sampling distribution –Testing of hypothesis –Test of significance for proportion and percentage – Test of significance for means – Test of significance for standard deviation.

Unit V: Test of significance (Small samples): Introduction – Test of significance based on t-distribution – Test of significance based on F-test.

TEXT BOOK:

Statistics by S.Arumugam and Isaac, New Gamma Publishing house, Edition July 2013.

Unit I : Chapter 2: Section 2.1 to 2.4, Chapter III Section 3.1

Unit II : Chapter 6: Section 6.1 - 6.3

Unit III: Chapter 8: Section 8.1 - 8.3

Unit IV: Chapter 14: Section 14.1 - 14.5

Unit V : Chapter 15: Section 15.1, 15.2

REFERENCE BOOK:

Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Published by Sulthan Chand & Sons, 11th Edition.

ALLIED MATHEMATICS FOR PHYSICS AND CHEMISTRY STUDENTS

I SEMESTER			
ALLIED MATHEMATICS I - STATISTICS AND CALCULUS			
Hrs/Week: 6	Hrs/Sem: 6 x 15 = 90	Hrs./ Unit : 18	Credits

OBJECTIVES:

1. To enable the students to understand physical science by a knowledge of elementary calculus.
2. To introduce various statistical tools to satisfy the need of concept personals.

UNIT I: Measures of Central Tendency – simple average – Mean, Median & Mode – Geometrical mean and Harmonic mean.

UNIT II: Measures of dispersion range-quartile deviation-standard deviation and mean deviation – coefficient of variation.

UNIT III: Correlation and regression: Scatter diagram – Karl Pearson’s Coefficient of Correlation – properties –Rank Correlation- lines of regression - regression coefficient and properties.

UNIT IV: Pedal equations - Curvature – Radius of Curvature in Cartesian ,parametric & polar co-ordinates – Evolute -Circle and centre of curvature.

Unit V: Beta and Gamma functions.

TEXT BOOKS:

1. Statistics by S. Arumugam and Isaac , New Gamma Publications, Edition 2013.
2. Calculus by S.Arumugam and Isaac, New Gamma Publications, Edition 2005.

Unit I : TB 1: Chapter II Section 2.1 - 2.4

Unit II : TB 1: Chapter III Section 3.1

Unit III :TB 1: Chapter VI Section 6.1 – 6.3

Unit IV :TB 2 Part I Chapter III Section 3.3 – 3.5

Unit V :TB 2: Part II Chapter IV

REFERENCE BOOK:

1. Calculus Volume I & II by S. Narayanan &T.K.Manicavachagam Pillay, S.Viswanathan, Edition 2014.
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Published by Sulthan Chand & Sons, 11th Edition.

II SEMESTER

DSC 3

INTEGRAL & VECTOR CALCULUS

Hrs/Week: 5

Hrs/Sem: 5 x 15 = 75

Hrs./ Unit : 15

Credit:

OBJECTIVES:

1. To impart the knowledge of differentiation and integration.
2. To provide the students with the fundamental concepts, underlying principles, various mathematical techniques and methods such as Fourier series.

Unit I - Evaluation of definite integrals- integration by parts – Jacobian.

Unit II - Evaluation of integrals using Beta and Gamma functions.

Unit III -Double and Triple integrals – Evaluation of Double and Triple Integrals - change of variables.

Unit IV – Vector Differentiation – gradient – curl – divergent – solenoidal – irrotational – formulae involving gradient, curl and divergent.

Unit V – Vector Integration – line integral – Surface integral –Gauss, Stoke's & Green's Theorem (without proof) and Problems.

TEXT BOOK:

1. Calculus by S. Arumugam & Issac , New Gamma Publications-Edition 2005.
2. Analytical Geometry of 3D and Vector Calculus by S. Arumugam & Issac, New Gamma Publications-Edition 2011.

Unit I : TB 1: Part II - Chapter II : Section 2.6,2.7& Part I-3.9

Unit II : TB 1: Part II - Chapter IV

Unit III: TB 1: Part II-Chapter III

Unit IV:TB 2: Part B-Chapter V

Unit V: TB 2: Part B Chapter VII

REFERENCE BOOK:

1. Integral Calculus by K.S. Rawat, Published by SARUP& Sons, Edition 2008.

II SEMESTER

DSC 4

ANALYTICAL GEOMETRY OF 3D

Hrs/Week:5

Hrs/Sem: 5 x 15 = 75

Hrs./ Unit : 15

Credits :

OBJECTIVE:

1. To give more knowledge of the geometrical figures through algebraic methods.

2. To find the equation of the sphere and the equation of tangent plane to the sphere.

Unit I Direction cosines - Direction ratios - Angle between two lines.

Unit II Planes – Standard forms – Angle between planes – Length of perpendicular - Bisectors of two planes – Parallel planes.

Unit III Lines – Symmetrical form – Plane and straight line - Image of a point – Image of a line.

Unit IV A Plane and a Straight Line - Coplanar lines – Skew lines – Length & equations of shortest distance between two lines.

Unit V The Sphere – Plane section of sphere – Tangent plane – Touching spheres – Intersection of spheres.

TEXT BOOKS:

1. Analytical Geometry 3-D & Vector Calculus by S. Arumugam and Isaac, New Gamma Publication House, 2011 Edition.

Unit I : Chapter I

Unit II : Chapter II

Unit III: Chapter III Section 3.1

Unit IV: Chapter III Section 3.2

Unit V : Chapter IV

REFERENCE BOOK:

1. Analytical Geometry of Three Dimension, T.K. Manickavachagam Pillay & Narayanan., S. Vishwanathan - Edition 2007.

II SEMESTER

DSC 5 MATHEMATICAL STATISTICS – II

Hrs/Week: 6 Hrs/Sem: 6 x 15 = 90 Hrs./ Unit : 18 Credits :

OBJECTIVES

1. To introduce various statistical tools to satisfy the need of concept personals.
2. To impart a knowledge about the statistical distributions.

Unit I: Probability: Introduction – Probability -Conditional Probability – Properties of Independent Events – Baye’s theorem - Problems.

Unit II: Random variables: Introduction –Random variables - Discrete Random Variable – Continuous Random Variable - Distribution function – Mathematical Expectations.

Unit III: Moments, Skewness and Kurtosis: Introduction – Moments - Karl Pearson’s coefficient of skewness – kurtosis - Moment generating functions and their properties – Cumulant Generating function -Characteristic function.

Unit IV: Some Special Distributions: Binomial and Poisson distribution – Moments of Binomial and Poisson distribution –Recurrence formula of Moments –Fitting of Binomial and Poisson distribution.

Unit V: Normal Distribution:Standard normal distribution – Properties – Fitting of Normal distribution.

Text Book

1. Statistics by S.Arumugam and Isaac, New Gamma Publishing house, Edition 2013.

Unit I : Chapter XI

Unit II : Chapter XII Section-12.0 – 12.4

Unit III : Chapter III and Chapter XII: Section 12.5, 12.6

Unit IV : Chapter XIII Section 13.0 – 13.2

Unit V : Chapter XIII Section 13.3

Reference Book:

1. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Published by Sulthan Chand & Sons, 11th Edition.

II SEMESTER			
ALLIED MATHEMATICS II -ALGEBRA & DIFFERENTIAL EQUATIONS			
Hrs/Week: 6	Hrs/Sem: 6 x 15 = 90	Hrs/ Unit : 18	Credits

OBJECTIVE:

1. To enable the students to understand physical science by a knowledge of elementary calculus.
2. To solve differential equations of first order and second order with constant coefficients.

UNIT I: Theorems on theory of Equation – Relation between roots and coefficients – Symmetric functions of roots in terms of coefficients.

UNIT II: Transformation of Equations – Reciprocal Equations.

UNIT III: Approximate solutions of numerical equations using Newton’s method and Horner’s method.

UNIT IV: First order higher degree Differential equations - Solvable for p, x and y- Clairaut’s form

UNIT V: Linear differential equation with constant coefficients- particular integrals of the form $f(x) e^{ax}$, x^n .

TEXT BOOK:

Classical Algebra by Joseph A. Mangaladoss, S. Firthous Fatima, M. Himaya Jaleela Begum and Dr. Syed Ali Fathima, Presi – Persi Publications – Edition 2016.

2. Differential Equations & Applications by S. Arumugam and Issac, New Gamma Publications—Edition 2008.

Unit I : **TB 1:** Chapter I: Section 1.1, 1.2 & Chapter II: Section 2.1.

Unit II : **TB 1:** Chapter II: Section 2.2 & Chapter IV: Section 4.1-4.4

Unit III : **TB 1:** Chapter V: Section 5.1, 5.2

Unit IV : **TB 2:** Chapter I: Section 1.7

Unit V : **TB 2:** Chapter II: Section 2.3

REFERENCE BOOK:

1. Algebra by Arumugam and Issac, New Gamma Publications – Edition 2011.

2. Differential Equation & Vector Calculas by Joseph A. Mangaldoss, Presi – Persi Publications, Edition 2012.

III SEMESTER			
DSC 5	Real Analysis I		
Hrs/Week: 5	Hrs/Sem: 75	Hrs/Unit: 15	Credits: 4

Objectives:

1. To find the relation between the bounded and monotonic sequences
2. To test the behaviour of the series.

UNIT I: Sequences-Bounded Sequences – Monotonic – Convergent – Divergent and Oscillating sequences – Algebra of limits.

UNIT II: Behaviour of Monotonic Sequences - Some Theorems on Limits - Subsequences – Limit points - Cauchy Sequences.

UNIT III: Series of positive terms – Convergence of Geometric, Harmonic series – Cauchy's General principle of convergence of series – Comparison test – Summation of Series: Binomial Series – Exponential series – Logarithmic Series.

UNIT IV: Kummer's test – D'Alembert's Ratio test – Raabe's test – De Morgan and Bertrand's test – Gauss's test – Cauchy's root test – Cauchy's condensation test (without proof).

UNIT V: Series of arbitrary terms: Alternating Series – Absolute Convergence – Tests for Convergence of series of arbitrary terms – Dirichlet's and Abel's test.

TEXT BOOK:

1. Sequences & Series by S Arumugam & Isaac New Gamma Publishing House, Edition 2002.
2. Sequences and Series and Trigonometry by Joseph A. Mangaladoss Presi-Persi Publications, 2013 edition.

Unit I: TB1 Chapter III: Section 3.1 to 3.6.

Unit II: TB1 Chapter III: Section 3.7 to 3.11

Unit III: TB1 Chapter IV: Section 4.1, 4.2. TB2 Chapter VI : Section 6.1 to 6.3

Unit IV: TB1 Chapter IV: Section 4.3, 4.4

Unit V: TB1 Chapter V: Section 5.1, 5.2, 5.3

REFERENCE BOOK:

Real Analysis by John M. Howie, Springer International Edition, published by Springer Private Limited, New Delhi.

SEC – I Introduction to Computers (Common)

SEC II (MOOC-NPTEL)(SAF)

III SEMESTER

NME I MATHEMATICS FOR COMPETITIVE EXAMINATION - I

Hrs /Week:2

Hrs / Sem: 2 x 15 = 30 Hrs/Unit : 6

Credits:2

OBJECTIVE:

1. To enable the students to assimilate the fundamental concepts and techniques for solving the mathematical problems
2. To enable the students to attend all types of entrance examinations.

Unit I : Average

Unit II: Problems on Numbers

Unit III: Problems on ages

Unit IV: Percentage

Unit V:Odd man out and series

TEXT BOOK:

Quantitative Aptitude by R.S. Aggarwal published by S.Chand & Co., Ltd., Edition 2011(without data sufficiency questions).

Unit I : Chapter 6

Unit II: Chapter 7

Unit III: Chapter 8

Unit IV: Chapter 10

Unit V: Chapter 35

REFERENCE BOOK:

Quantitative Aptitude by R. Gupta published by Ramesh Publishing House, Edition 2012.

IV SEMESTER			
DSC6	ABSTRACT ALGEBRA		18UCMA41
Hrs/Week:5	Hrs/Sem:75	Hrs/Unit:15	Credits:4

OBJECTIVES:

1. To introduce various structures like groups, rings, ideals and to study the similarities of such structures.
2. To impart the knowledge of group theory and ring theory.

UNIT I : Groups: Semigroups and Groups – Homomorphisms - Subgroups and Cosets - Cyclic groups .

UNIT II : Permutation groups – Generators and Relations-Normal subgroups and Quotient Groups – Isomorphism theorems .

UNIT III : Automorphisms – Conjugacy and G-sets- Cyclic decomposition - Alternating group A_n - Simplicity of A_n .

UNIT IV : Rings: Definition and Examples – Elementary properties of rings – Types of Rings – Subring and characteristics of ring – Additional example of rings.

UNIT V: Ideals and Homomorphism: Ideals– Homomorphism – Sum and direct sum of ideals - Maximal and prime ideals - Nilpotent and nil ideals – Zorn's Lemma.

TEXTBOOK:

Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Published by Cambridge University Press, Second Edition.

Unit I: Chapter 4: Section 4.1-4.4

Unit II: Chapter 4: Section 4.5, 4.6 and Chapter 5: Section 5.1, 5.2

Unit III: Chapter 5: Section 5.3, 5.4 and Chapter 7: Section 7.1-7.3

Unit IV: Chapter 9: Section 9.1 -9.5

Unit V: Chapter 10: Section 10.1 – 10.6

REFERENCE BOOK:

Modern Algebra by S. Arumugam & Isaac – Scitech Publications (India) Pvt Ltd, Edition 2012.

IV SEMESTER			
SEC IV	TRIGONOMETRY		
Hrs/Week:2	Hrs/Sem: 2 x 15=30	Hrs./ Unit :15	Credits:4

OBJECTIVES:

1. To study the properties of multiple angles of trigonometrical ratios.
2. To have a better idea about logarithms of complex quantities through Trigonometry.

Unit I: Introduction – Basic formulae - Expansions: Expansions of $\cos n\theta$ and $\sin n\theta$ -Expansion of $\tan n\theta$ in powers of $\tan \theta$ -Expansion of $\tan (A+B+C+\dots)$.

Unit II: Powers of sines and cosines of θ in terms of functions of multiples of θ -Expansion of $\sin^n \theta$ and $\cos^n \theta$ when n is positive integer.

Unit III: Hyperbolic Functions:-Relation between hyperbolic functions-Relation between hyperbolic and circular function.

Unit IV: Inverse Hyperbolic functions

Unit V: Resolution into factors ;logarithms of complex quantities-To resolve into factors the expression $x^n - a^n$ - To resolve into factors the expression $x^n - a^n$.

TEXT BOOK:

S.Narayanan and T.K.Manicavachagom Pillay, "Trigonometry"- S.Viswanathan Printers and Publishers, Edition 2007.

Unit I : Chapter III: Sec 1,2

Unit II: Chapter III: Sec 4.0,4.1

Unit III: Chapter IV: Sec 2.0,2.1,2.2

Unit IV: Chapter IV:Sec 2.3

Unit V: Chapter V:Sec 1,2,3

REFERENCE BOOKS:

1. Joseph A. Mangaladoss;"Sequences and Series and Trigonometry" Persi Publications, May 2013.
2. Dr.S. Arumugam and A. Thangapandi Issac, "Sequences and Series and Trigonometry", New Gamma Publishing House, Edition 2002.

IV SEMESTER
NME II MATHEMATICS FOR COMPETITIVE EXAMINATION - II
Hrs /Week:2 Hrs / Sem: 2 x 15 = 30 Hrs/Unit : 6 Credits:2

OBJECTIVE:

1. To enable the students to assimilate the fundamental concepts and techniques for solving the mathematical problems.
2. To enable the students to attend all types of entrance examinations.

Unit I : Profit and Loss

Unit II : Ratio and Proportion

Unit III : Time and Work

Unit IV : Simple Interest

Unit V : Compound Interest

TEXT BOOK:

1. Quantitative Aptitude by R.S. Aggarwal published by S.Chand & Co., Ltd., Edition 2011(without data sufficiency questions).

Unit I: Chapter 11

Unit II: Chapter 12

Unit III: Chapter 15

Unit IV: Chapter 21

Unit V: Chapter 22

REFERENCE BOOK:

Quantitative Aptitude by R. Gupta published by Ramesh Publishing House, Edition 2012.

VSEMESTER			
DSC 7	LINEARALGEBRA		
Hrs/ Week: 4	Hrs/Sem:60	Hrs/Unit:12	Credits:

OBJECTIVES:

1. To enrich the students with a knowledge of the basic concepts of Vector Space.
2. To introduce the Inner Product space and its properties.

UNIT I: Vector Spaces-Definition and examples-Subspaces-Linear Transformations

UNIT II: Linear Span of a set -Linear dependence and independence-Basis dimension-Finite dimension.

UNIT III: Theorems on dimension-Rank and Nullity-Matrix of a Linear transformation.

UNIT IV: Inner product space -Definition and examples - Orthogonality - Gram Schmidt Orthogonalisation process- Orthogonal complement.

UNIT V: Matrices-Rank of a matrix-Simultaneous linear equation-Characteristic equations of a matrix - Eigen values & Eigen vectors - Cayley Hamilton theorem and application.

TEXTBOOK:

1. Modern Algebra by Dr. S. Arumugam and Issac-Scitech Publications (India) Pvt Ltd- Edition 2012.

Unit I: Chapter V: Section 5.1, 5.2, 5.3

Unit II: Chapter V: Section 5.4, 5.5, 5.6 (upto theorem 5.22)

Unit III: Chapter V: Section 5.6 (theorem 5.22 - 5.28), 5.7, 5.8

Unit IV: Chapter VI: Section 6.1, 6.2, 6.3

Unit V: Chapter VII: Section 7.1, 7.2, 7.3, 7.7, 7.8

REFERENCE BOOK:

University Algebra by N.S. Gopalakrishnan, Second Edition, New Age International Pvt, Ltd.

V SEMESTER	
DSC 8	REAL ANALYSIS-II
Hrs/Week: 4 Hrs/Sem: 4x 15 = 60 Hrs./ Unit : 12 Credits : 4	

OBJECTIVES:

1. To impart the knowledge of the basic terms of the analysis like open set, closed set, closure etc.

2. To understand the concept of complete metric space ,connected metric space and compact metric space.

Unit I: Countable sets - Uncountable sets- Metric spaces- Bounded sets - Open Ball - Open sets – Subspaces- Interior of a set.

Unit II: Closed sets – Closure - Limit point - Dense sets - Complete metric space - Cantor’s intersection theorem-Baire’s category Theorem.

Unit III: Continuity of functions- Continuity of composition of functions- Equivalent conditions for continuity – Algebra of continuous functions- Homeomorphism - Uniform continuity.

Unit IV: Connectedness: Introduction – Connected metric space - Equivalent characterization of Connectedness - Connected subsets of R - Connectedness and continuity - Intermediate Value theorem.

Unit V: Compactness: Introduction - Compact Metric spaces – Compact Subsets of R - Heine Borel theorem –Compactness and Continuity.

Text Book:

Modern Analysis by Dr. S. Arumugam and Mr. A. Thangapandi Isaac, New Gamma Publishing House, Edition June 2012.

Unit I : Chapter 1: Section 1.2, 1.3 Chapter 2: Section 2.1- 2.6
Unit II : Chapter 2: Section 2.7 - 2.10 Chapter 3: Section 3.1, 3.2
Unit III : Chapter 4: Section 4.1 - 4.3
Unit IV : Chapter 5: Section 5.1 - 5.3
Unit V : Chapter 6: Section 6.1,6.2,6.4.

REFERENCE BOOK:

Methods of Real Analysis by Richard R. Goldberg, Oxford and IBH Publishing CO. PVT. LTD., Indian Edition 1970.

V SEMESTER

DSC 9

DIFFERENTIAL EQUATIONS

Hrs/Week: 4

Hrs/Sem: 4 x 15 = 60

Hrs./ Unit : 12

Credits :

OBJECTIVES:

1. To enrich the students with a knowledge of differentiation of vectors.
2. To acquire knowledge about Laplace transform.

Unit I : First order higher degree Differential equation - solvable for p, x and y-Clairaut's form-linear differential equation with constant coefficients-particular integrals of the form $f(x) e^{ax}$, x^n , $e^{ax} x^n$.

Unit II: Homogenous equations- Linear differential equations with variable coefficients- equations reducible to homogenous equations.

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Unit III: Formation of Partial Differential Equation - First order PDE - Solutions - Standard Form - Charpit's Method.

Unit IV: Partial Differential Equations of higher order - Homogenous differential Equations - Solutions

Unit V: Applications of Differential Equations - Orthogonal Trajectories - Growth and Decay - Continuous Compound Interest-Braachistochrone Problems - Tautochronous Property of the Cycloid.

TEXT BOOK:

1. Differential equation & Applications by S. Arumugam, New Gamma Publications-Edition 2008.

Unit I : Chapter I: Section 1.7 & Chapter II Section 2.3

Unit II : Chapter II: Section 2.4, 2.5

Unit III : Chapter IV

Unit IV : Chapter V

Unit V : Chapter VI : Section 6.1- 6.5

REFERENCE BOOK:

1. Differential Equation and Vector Calculus by Joseph A. Mangaladoss, Presi-Persi Publications.

V SEMESTER			
DSC 10	STATICS		
Hrs/ Week:4	Hrs/Sem:60	Hrs/Unit: 12	Credits: 4

UNIT I : Introduction - Forces Acting at a point- Parallelogram law of forces -Lami's Theorem- Problems.

UNIT II : An extended form of the parallelogram law of forces- Resolution of a force – Theorem on resolved parts – Problems.

UNIT III: Parallel Forces and Moments - Resultant of two parallel forces- Center of two parallel forces- Varignon's Theorem of Moments.

UNIT IV: Equilibrium of three forces acting on a rigid body- Three Coplanar Forces– Theorems and Problems.

UNIT V: Friction- Laws of friction – Angle of friction – Equilibrium of a body on a rough inclined plane- Problems.

TEXTBOOK

1. Statics by Dr. M.K. Venkataraman - Edition July 2013 – Agasthiar Publications.

Unit I: Chapter I, Chapter II (Sec: 2.1 to 2.9)

Unit II: Chapter II (Sec 2.10 to 2.16)

Unit III: Chapter III (Sec: 3.1 to 3.12)

Unit IV: Chapter V (Sec: 5.1 to 5.6)

Unit V: Chapter VII (Sec 7.1 to 7.12)

REFERENCEBOOK:

Mechanics by P. Durai Pandian, S. Chand Limited, 1995, Laxmi Durai Pandian, Muthamil Jeyaprakasam – Edition 2007.

V SEMESTER	
DSC11	NUMBER THEORY
Hrs/Week: 4Hrs/Sem: 4 x 15 = 60Hrs./ Unit : 12Credits:	

OBJECTIVE:

1. To make the students understand the basic properties of the integers.
2. To improve the students ability of Mathematical thinking.

UNIT I: Divisibility Theory: Early Number theory – The Division algorithm – the Greatest Common divisor – The Euclidean Algorithm -The Diophantine Equation $ax + by = c$.

UNIT II: Primes and their distribution: The fundamental theorem of arithmetic The Theory of Congruences: Carl Friedrich Gauss - Basic Properties of Congruence - Binary and Decimal Representations of Integers - Linear Congruences and the Chinese Remainder Theorem.

UNIT III: Fermat's Theorem: Pierre de Fermat - Fermat's Little Theorem and Pseudoprimes - Wilson's Theorem - The Fermat-Kraitchik Factorization Method.

UNIT IV: Number-Theoretic Functions: The sum and number of divisors - The Mobius inversion formula - The Greatest Integer Function.

UNIT V: Euler's Generalization of Fermat's Theorem: Leonhard Euler - Euler's Phi-Function - Euler's Theorem - Some Properties of the Phi-Function.

TEXT BOOK :

1. Elements of Number Theory by David M. Burton, Seventh Edition, McGraw Hill Higher Education publications, New Delhi.

Unit I: Chapter 2

Unit II: Chapter 3 Section 3.1 & Chapter 4

Unit III: Chapter 5

Unit IV: Chapter 6

Unit V: Chapter 7

REFERENCE BOOK:

Number Theory by Andrews George E. Andrews - Hindustan Publishing Corporation (India) 1989.

V SEMESTER		
DSE 1A	COMBINATORIAL MATHEMATICS	
Hrs/Week: 4	Hrs/Sem: 4 x 15 = 60	Hrs./ Unit : 12

OBJECTIVES:

1. To impart knowledge of applications of mathematics especially in the field of Combinations and permutations.
2. To impart knowledge about recurrence relations, generating functions incidence matrices and the inclusion-exclusion principle.

Unit I: Selections & Binominal Coefficients – Permutations - ordered Selections - unordered selections – Binomial Theory.

Unit II: Parings Problems -Parings within a set - paring between sets – An optimal assignment problem.

Unit III: Recurrence - Fibonacci – type relation using generating functions - miscellaneous Methods.

Unit IV: The Inclusion – Exclusion Principle - The Principle - Rook polynomials.

Unit V: Block Design and Error correcting codes - Block designs - Square Block Designs.

TEXT BOOK:

A first course in Combinatorial Mathematics by Ian Anderson, Edition 1979 (Oxford Applied Mathematics and Computing Science Series).

Unit I : Chapter I & Chapter II

Unit II : Chapter III

Unit III: Chapter IV

Unit IV : Chapter V

Unit V: Chapter VI

REFERENCE BOOK:

Introduction to Combinatorics – C.L.Liu, McGraw-Hill Book of Company, copyright @1968.

V SEMESTER	
DSE 1B	FUZZY MATHEMATICS
Hrs/Week: 4Hrs/Sem: 4 x 15 = 60Hrs./ Unit : 12Credits:	

OBJECTIVE:

It's a powerful Mathematical tool for Modeling and controlling uncertain system in Industry.

UNIT I: Fuzzy Relation and Fuzzy Mapping

UNIT II: Fuzzy Relation and Fuzzy Logic

UNIT III: Fuzzy Groups and Fuzzy Rings

UNIT IV: Fuzzy Field and Fuzzy Linear Space

UNIT V: Fuzzy Metric Space

TEXT BOOK:

Fuzzy Mathematical Concept by S. Nanda and N. R. Das, Narosa Publications.

Unit I : Chapter 1

Unit II: Chapter 2

Unit III: Chapter 3

Unit IV: Chapter 4

Unit V: Chapter 8

REFERENCE BOOK

Fuzzy Logic Mathematical Tools for Approximate Reasoning by Giangiacomo Gerla.

V SEMESTER			
DSE 2A	OPERATION RESEARCH I (E Learning)		
Hrs /Week:4Hrs / Sem: 4 x 15 = 60	Hrs/Unit : 12	Credits:	

OBJECTIVES:

1. To familiarize the students with the techniques of Linear Programming problem to be applied.
2. To be familiar with the computational procedure of Simplex methods.

Unit I:Mathematical Formulation of LPP – General Linear Programming Problem – LP-Solution – Some Terminologies for Solution – Some Important Results – Graphical Method.

Unit II : Simplex Method, Canonical and Standard form of an LPP, Slack and Surplus variable - Simplex Algorithm.

Unit III :Basic Feasible solution - Artificial variable and Big M-Method – Unrestricted Variables – Unbounded Solution – No Feasible Solution.

Unit IV: Duality – Mathematical formulation of Dual - Duality Theorem - Duality in Simplex Method.

Unit V: Dual simplex method – Dual simplex Algorithm – Revised Simplex Method – Revised Simplex Algorithm.

TEXT BOOK: Epg pathashala.

Unit I: M-01: Module 1 sec 1.1,1.1.1 , 1.2,1.2.1, 1.2.2, 1.3

Unit II: M-02: Module 2 Sec 2.1, 2.1.1, 2.1.2, 2.1.3, 2.1.5.

Unit III: M-02:Module 2 Sec 2.1.4, 2.2, M-03: Module 3 Sec 3: 3.2, 3.4, 3.5

Unit IV: M-04: Module 4 Sec 4.1, 4.1.1, 4.1.2, 4.2

Unit V: M-05: Module 5 Sec 5.1, 5.1.1, 5.2

REFERENCE BOOK:

1. Operations Research by Kanti Swarup, P. K. Gupta, Man Mohan - fourteenth edition 2008 – Sultan Chand & Sons, Educational Publisher, New Delhi.
2. Operations Research By P.R. Vittal, Margham Publications, Edition 2013.

V SEMESTER			
DSE 3 B	PROGRAMMING IN C- I	18UEMA5B	
Hrs/Week: 4	Hrs/Sem: 4 x 15 = 60	Hrs./ Unit : 12	Credits: 4

OBJECTIVES:

1. To learn the basic programming concepts.
2. To have an in-depth knowledge of Algorithms and Programs in C.

Unit I: Constants – Variables and data types: Introduction – Character set – C tokens – keywords and Identifiers – Constants – Variables – Data types – Declaration of variables.

Unit II: Operations and expressions: Introduction – Operators – Special operators – Arithmetic expressions- Evaluation of Expressions – Precedence of Arithmetic – Operator Precedence and Associativity.

Unit III: Managing input and output operations: Introduction – Reading a character – Writing a character – Formatted Input – Formatted Output

Unit IV : Decision making and Branching: Introduction – Decision Making with if statement – Switch statement – The ?: operator – The goto statement.

Unit V: Decision making and Looping: Introduction – The While statement – The do statement – The for statement – Jumps in loops.

TEXT BOOK:

Programming in ANSI C by E. Balagurusamy- McGraw Hill Education Private -Sixth Edition.

Unit I : Chapter 2

Unit II : Chapter 3

Unit III : Chapter 4

Unit IV : Chapter 5

Unit V : Chapter 6

REFERENCE BOOK:

1. Programming in C by D.Ravichandran-New age international publishers- Edition 2011.

III SEMESTER			
SEC 1		NUMERICAL ABILITY - I	
Hrs /Week:2	Hrs / Sem: 2 x 15 = 30	Hrs/Unit : 6	Credits:

OBJECTIVE:

1. To enable the students to assimilate the fundamental concepts and techniques for solving the mathematical problems.
2. To enable the students to attend all types of entrance examinations

Unit I Average**Unit II** Problems on Numbers**Unit III** Percentage**Unit IV** Profit and loss**Unit V** Time and Work**TEXT BOOK:**

Quantitative Aptitude by R.S. Aggarwal published by S.Chand & Co., Ltd., Edition 2010 (without data sufficiency questions).

Unit I: Chapter 6

Unit II: Chapter 7

Unit III: Chapter 10

Unit IV: Chapter 11

Unit V: Chapter 15

REFERENCE BOOK:

Quantitative Aptitude by R. Gupta published by Ramesh Publishing House, Edition 2012.

VISEMESTER			
DSC 12	COMPLEXANALYSIS		
Hrs/Week:5	Hrs/Sem: 5 x 15= 75	Hrs./ Unit :15	Credits:4

OBJECTIVES:

1. To enrich the student with the fundamental ideas and theorems about complex plane, analytic forms, linear transformations ,complex integration, power series expansions and calculus of residues.
2. To introduce the concepts of differentiation, integration forms of real variables.

Unit I:Differentiability- Analytic functions - Cauchy's Riemann equations- Harmonic functions.

Unit II:Bilinear Transformations – Cross Ratio - Fixed Points of Bilinear Transformation.

Unit III:Complex Integration – Definite integral - Cauchy's theorem - Cauchy's integral Formula - Higher Derivatives.

Unit IV:Series expansion -- Taylor's Series - Laurent's Series - Zeros of an Analytic function - Singularities.

Unit V:Residues - Cauchy's Residues theorem - Evaluation of Definite integrals - Type 1 and Type 2

TEXT BOOK:

1. Complex Analysis by S.Arumugam, A.Thangapandi Isaac and A.Somasundaram, SCITECH Publications (India) Pvt Ltd., -- Edition 2007.

Unit I : Chapter II : Section 2.5 – 2.8

Unit II : Chapter III : Section 3.1 – 3.5

Unit III: Chapter VI : Section 6.1 – 6.4

Unit IV: Chapter VII : Section 7.1 – 7.4

Unit V : : Chapter VIII : Section 8.1 – 8.3 (Except type 3)

REFERENCE BOOKS:

1. Churchill R.V and J.W.Brown-“Complex variables and Applications”- Fourth Edition –McGraw Hill International Editions.

2. Ponnuswamy.S-“Foundation of Complex Analysis”,Narose Publication House New Delhi,2nd edition 2005.

3. Duraipandian.P and Lakshmi Duraipandian-“Complex Analysis”-Emerald Publications,Chennai(2001).

VI SEMESTER			
DSC 13	GRAPH THEORY		
Hrs/ Week:5	Hrs/Sem:75	Hrs/Unit:15	Credits:4

OBJECTIVES:

1. To provide a basic foundation for topics like Subgraphs, Degree sequences, Connectedness, etc.
2. To introduce Eulerian, Hamiltonian graphs, Trees and Planar.

UNIT I: Graphs – Degrees - Subgraphs – Isomorphism - independent sets and coverings - intersection graph and line graph – Matrices of a graph - Operations on graphs.

UNIT II: Degree sequences - Walks, Trails and Paths - Connectedness - Connectivity.

UNIT III: Eulerian Graphs - Hamiltonian Graphs - Characterization of Trees - Centre of a tree.

UNIT IV: Matchings - Matchings in Bipartite graphs - Planar graphs - Properties.

UNIT V: Chromatic number - chromatic index - The Five Colour theorem - Four Colour Problem. Chromatic polynomial of graphs

TEXTBOOK:

Invitation to Graph Theory by S. Arumugam & S. Ramachandran SCITECH Publications (India) Ltd., Reprint 2014.

Unit I: Chapter II

Unit II: Chapter III & IV

Unit III: Chapter V & VI

Unit IV: Chapter VII & VIII

Unit V: Chapter IX

REFERENCE BOOK:

Graph Theory by G. Suresh Singh - PHI Learning Pvt. Ltd - 2010.

VI SEMESTER			
Core 14	NUMERICAL METHODS		
Hrs/ Week:4	Hrs/Sem : 4x 15 = 60	Hrs./Unit : 12	Credits :

OBJECTIVES:

1. To introduce the idea of finite differences and the associated concepts which have important applications in Numerical Method.

2. To enable the students to solve ordinary differential equations numerically.

Unit I: Finite Differences- Difference operators, Other difference operator, Sum of series.

Unit II: Interpolation-Newton's forward interpolation formula, Newton's Backward interpolation formula, Newton's central interpolation formula-Strilling's method, Lagrange's formula and its inverse formula, Newton's Divided Difference interpolation formula.

Unit III: Numerical derivatives – Derivatives for equally spaced data.

Unit IV: Numerical integration – Newton- Cote's Quadrature formula – Trapezoidal rule – Simpson's one third rule – Simpson's three eight rule.

Unit V: Numerical solution of ordinary differential equations – Euler's method - Taylor's series method – Runge Kutta methods – Predictor – Corrector method.

TEXT BOOK

1. Numerical Methods by Dr.S.Arumugam, Issac and Somasundaram, Scitech Publication, 2007 Reprint.

Unit I: Chapter VI - Section: 6.0-6.2 and 6.4

Unit II: Chapter VII - Section: 7.0-7.6

Unit III: Chapter VIII- Section : 8.0-8.4

Unit IV: Chapter VIII -Section:8.5, 8.6.

Unit V : Chapter X- Section: 10.0,10.1, 10.3- 10.6

REFERENCE BOOK:

1. Numerical Methods by Dr.A.Kandasamy & Dr.K.Thilagavathy and Dr.K.Gunavathi, S.Chand & Company Pvt Ltd, Delhi, Reprint 2015.

VI SEMESTER			
DSE4A	DYNAMICS		18UEMA6A
Hrs/Week: 4	Hrs/Sem: 4 x 15 = 60	Hrs./ Unit : 12	Credits :4

OBJECTIVES:

1. To have an in-depth knowledge of objects in motion
2. To solve problems in elementary Dynamics

UNIT I: Projectiles – Path of a Projectile – Characteristics of the motion of a Projectile -Problems.

UNIT II: Collusion of elastic bodies - Laws of Impact - Problems.

UNIT III: Simple Harmonic Motion – Geometrical representation of Simple Harmonic Motion - Problems.

Unit IV: Composition of two SHM of the same period in the same straight line - Composition of two SHM of the same period in two perpendicular directions – Motion of particle suspended by a spiral spring –horizontal oscillation of a particle tied to an elastic spring.

Unit V: Motion under the action of the central force – Velocity and Acceleration in Polar Co-ordinates- Differential Equation of central orbit- Pedal Equation of central orbit-Problems.

TEXT BOOK:

1. Dynamics by Dr. M.K. Venkatraman - Edition Jan 2014 – Agasthiar Publications.

Unit I: Chapter VI (Sec: 6.1 to 6.8)

Unit II:Chapter VIII (Sec:8.1 to 8.4)

Unit III:Chapter X (Sec: 10.1 to 10.5)

Unit IV:Chapter X (Sec: 10.6 to 10.10)

Unit V:Chapter XI (Sec 11.1 to 11.11)

REFERENCE BOOK:

Mechanics by P. Durai Pandian, S. Chand Limited, 1995.

VI SEMESTER

DSE 3A

OPERATIONS RESEARCH – II

Hrs/Week: 4 Hrs/Sem: 4 x 15 = 60 Hrs./ Unit : 12Credits :

OBJECTIVES:

1. To familiarize the students with the techniques of O.R to be applied.
2. To be familiar with the computational procedure of optimality.

Unit I: Mathematical formulation of TP – Loops in Transportation Table – Algorithm to Solve a Transportation Problem – Method of find an initial BFS North- West Corner Rule – Least Cost Method – Optimality Test – Stepping Stone Method.

Unit II: Row(Column) Minima Method–Vogels Approximation Method – Modified Distribution Method – Some Special Cases of Transportation problems – Degeneracy in Transportation Problem – Unbalanced Transportation Problem.

Unit III: Assignment problem –Mathematical formulation of Assignment Problem – Hungarian Method for Solving Assignment problem – Variation of Assignment problem – The Travelling Salesman Problem.

Unit IV: Basic Terminologies – Two-Person Zero-Sum Game – Pure Strategies (Minimax and Maxmin Criterion) - Mixed Strategies: Game without Saddle Point

Unit V:Basic components of Network – Fulkerson’s Rule for Numbering Events – Rules for Drawing Network Diagram – Common Error in Drawing Networks – Critical Path Method(CPM) – Forward Pass Calculations – Backward Pass Calculations – Float (or Slack) of an Activity and Event.

TEXT BOOK:Epathsala.

Unit I : M-06: Module 1 - Sec 1.1, 1.1.1, 1.2, 1.3, 1.3.1, 1.3.2, 2.1, 2.1.1

Unit II : M-07: Module 1- Sec 1.3.3, 1.3.4, 2.1.2, 2.2, 2.2.1, 2.2.2

Unit III: M-08: Module 2-Sec 2.1, 2.1.1, 2.2, 2.2.1, 2.2.2

Unit IV: M-08: Module 1- Sec 1.1, 1.2, 1.3, 1.4

Unit V: M-25: Module 1-Sec 1.1, 1.2, 1.3, 1.4, 1.5, 1.5.1, 1.5.2, 1.5.3

REFERENCE BOOK:

1. Operations Research by Kanti Swarup, P. K. Gupta, Man Mohan - fourteenth edition 2008 – Sultan Chand & Sons, Educational Publisher, New Delhi.
2. Operations Research By P.R. Vittal, Margham Publications, Edition 2013.

VI SEMESTER			
DSE 4B	PROGRAMMING IN C- II		
Hrs/Week: 4	Hrs/Sem: 4 x 15 = 60	Hrs./ Unit : 12	Credits:4

OBJECTIVES:

To introduce the concepts of C language which will enable them to write programmes using functions and understand about File management in C.

Unit I : Arrays: Introduction – One dimensional Arrays - Two dimensional Arrays – Dynamic Arrays . Character Arrays and Strings: Introduction – Declaring, Reading and writing strings – String Handling functions.

Unit II : User-Defined function :Definition of functions – Category of functions – Nesting of function - Recursion

Unit III : Structures and Unions: Introduction – Define a structure – Array of structures – Structures and Functions – Size of structures.

Unit IV : Pointers : Introduction – Understanding Pointers – Declaring pointer variables – Chain of Pointers – Pointers and Arrays – Pointers to functions – Pointers and Structures.

Unit V : File management in C : Introduction – Defining and Opening a file – Closing a file – I/O operations on files-Random access to files.

TEXT BOOK:

Programming in ANSI C by E.Balagurusamy

Unit I : Chapter 7 and 8

Unit II : Chapter 9

Unit III : Chapter 10

Unit IV : Chapter 11

Unit V : Chapter 12

REFERENCE BOOK:

Programming in C by D.Ravichandran-New age international publishers-
Edition 2011.

VI SEMESTER			
SEC II	NUMERICAL ABILITY – II	18USMA61	
Hrs /Week:2	Hrs / Sem: 2 x 15 = 30	Hrs/Unit : 6	Credits:2

OBJECTIVE:

1. To enable the students to assimilate the fundamental concepts and techniques for solving the mathematical problems.
2. To enable the students to attend all types of entrance examinations.

Unit I : Time and Work.

Unit II : Time and Distance.

Unit III: Problems on Trains.

Unit IV:Logarithms.

Unit V :Heights and Distances

TEXT BOOK:

Quantitative Aptitude by R.S. Aggarwal published by S.Chand & Co., Ltd., Edition 2010 (without data sufficiency questions).

Unit I: Chapter 15

Unit II: Chapter 17

Unit III: Chapter 18

Unit IV: Chapter 23

Unit V: Chapter 34

REFERENCE BOOK:

Quantitative Aptitude by R. Gupta published by Ramesh Publishing House, Edition 2012.