MATHEMATICS
COMPLEMENTARY ELECTIVE COURSES FOR BSc COMPUTER SCIENCE PROGRAMME

COMPLEMENTARY ELECTIVE COURSE 1:

MATHEMATICS FOR COMPUTER SCIENCE I

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HOURS	MARKS		
					END SEM EXAM	INTERNAL	TOTAL
I	1C01 MAT-CS	4	3	3	40	10	50

COURSE OUTCOMES

CO1	Understand Successive differentiation and Leibnitz's theorem for the nth derivative of the product of two functions
CO2	Understand Fundamental theorem – Rolle's theorem, Lagrange's mean-value theorem and Cauchy's mean value theorem.
CO3	Understand Taylor's theorem, expansions of functions – Maclaurin's series, expansion by use of known series and Taylor's series.
CO4	Understand the method of finding limits of Indeterminate forms.
CO5	Understand Polar, Cylindrical and Spherical co-ordinates.
CO6	Understand Rank of a matrix, elementary transformation of a matrix, equivalent matrices, elementary matrices, Gauss-Jordan method of finding the inverse, normal form of a matrix and partition method of finding the inverse.
CO7	Understand solution of linear system of equations – method of determinants – Cramer's rule, matrix inversion method, consistency of linear system of equations, Rouche's theorem, procedure to test the consistency of a system of equations in n unknowns, system of linear homogeneous equations.
CO8	Understand Linear transformations, orthogonal transformation and linear dependence of vectors.
CO9	Understand methods of curve fitting, graphical method, laws reducible to the linear law, principles of least squares, method of least squares and apply the principle of least squares to fit the straight line $y = a+bx$, to fit the parabola $y=a+bx+cx^2$, to fit $y = ax^b$, $y =ae^{bx}$ and $xy^n=b$

1C01 MAT-CS: Mathematics for Computer Science I

Unit I Differential Calculus – Differentiation and Successive Differentiation (18 Hours)

Text: Differential Calculus, Shanti Narayan and P.K. Mittal

Quick review of basics of differentiation – Derivatives of standard functions, rules of differentiation, parametric differentiation. *(Questions should not be asked in the End Semester Examinations from the above sections for quick review)(*Relevant portions from sections 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10)

Text: Higher Engineering Mathemaics (41rd edition), B.S. Grewal,

Successive differentiation, standard results, preliminary transformations, use of partial fractions, Leibnitz's theorem for the nth derivative of the product of two Sections 4.1, 4.2

Unit II: Differential Calculus – Applications of Derivatives (22 Hours)

Text: Higher Engineering Mathematics (41st edition), B.S. Grewal, Khanna Pub.

Fundamental theorem – Rolle's theorem, Lagrange's mean-value theorem, Cauchy's mean-value theorem, Taylor's theorem (Generalised mean value theorem)(without proof), expansions of functions – Maclaurin's series, expansion by use of known series, Taylor's series, Indeterminate forms - form 0/0, form ∞/∞, form reducible to 0/0 form - form 0.∞, form ∞-∞, forms 0^0,1^∞, ∞^0 (Sections 4.3, 4.4, 4.5).

Unit III Linear Algebra - Matrices and System of Equations, Linear Transformations (20 Hours)

Text: Higher Engineering Mathematics (41st edition), B.S. Grewal, Khanna Pub.

Rank of a matrix, elementary transformation of a matrix, equivalent matrix,s elementary matrices, Gauss-Jordan method of finding the inverse, normal form of a matrix, partition method of finding the inverse, solution of linear system of equations – method of determinants – Cramer's rule, matrix inversion method, consistency of linear system of equations, Rouche's theorem, procedure to test the consistency of a system of equatios in n unknowns, system of linear homogeneous equations. Linear transformations, orthogonal transformation, vectors – linear dependence

Sections 2.8, 2.9, 2.10, 2.11, 2.12, 2.13

Unit IV Fitting of Curves

Text: Higher Engineering Mathematics (41st edition), B.S. Grewal, Khanna Pub.

Introduction, graphical method, laws reducible to the linear law, principles of least squares, method of least squares, to fit the straight line y=a+bx, to fit the parabola $y=a+bx+cx^2$

Sections 24.1, 24.2, 24.3, 24.4, 24.5

References

1. Differential and Integral Calculus, S. Narayanan and T.K.M. Pillay, S. Viswanathan Printers and Publishers, Chennai
2. Textbook of Matrices, Shanti Narayan and P.K. Mittal, S. Chand & Co.
3. Theory of and Problems of Matrices, Frank Ayres JR, Schaum's Outline Series, McGraw- Hill Book Company
4. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley
5. Calculus (10th edition), Anton, Bivens, Davis, Wiley-India
6. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	**Maximum Marks**
I	18	**40**
II	20	
III	18	
IV	10	
Total	**66**	

Pattern of Question Paper

Part A - **Short answer** (5 questions x Mark 1each = 5)
- ***Answer any 4 questions*** (4 *questions x Mark 1each = 4*)

Part B - **Short Essay** (10 questions x Marks 2 each = 20)
- ***Answer any 7 questions*** *(7 questions x Marks 2 each=14)*

Part C - **Essay** (7 questions x Marks 3 each = 21)
- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each = 20)
- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10).*

COMPLEMENTARY ELECTIVECOURSE 2:

MATHEMATICS FOR COMPUTER SCIENCE II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HOURS	MARKS		
					END SEM EXAM	INTERNAL	TOTAL
II	2C02 MAT-CS	4	3	3	40	10	50

COURSE OUTCOMES

CO1	Understand Functions of two or more variables, limits and continuity.
CO2	Understand partial derivatives, homogeneous functions, Euler's theorem on homogeneous functions, total derivative, differentiation of implicit functions and change of variables.
CO3	Understand Reduction formulae for trigonometric functions and evaluation of definite integrals $\int_0^{\frac{\pi}{2}} sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} cos^n x\, dx$ and $\int_0^{\frac{\pi}{2}} sin^p x\, cos^q x dx$.
CO4	Understand Substitutions and the area between curves, arc length, areas and length in polar coordinates.
CO5	Understand Double and Iterated Integrals over rectangles, double integrals over general regions, area by double integration, double integrals in polar form and triple integrals in rectangular co-ordinates.
CO6	Understand Eigen values, Eigen vectors, properties of Eigen values, Cayley- Hamilton theorem, reduction to diagonal form, similarity of matrices, powers of a matrix, reduction of quadratic form to canonical form and nature of a quadratic form

2C02 MAT-CS: Mathematics for Computer Science II

Unit I Differential Calculus – Partial Differentiation

Text: Differential Calculus, Higher Engineering Mathematics (41st edition), B.S. Grewal, Khanna Pub.

Partial Differentiation: Functions of two or more variables, limits, continuity, partial derivatives, homogeneous functions, Euler's theorem on homogeneous functions, total derivative, differentiation of implicit functions, change of variables.

Sections 5.1, 5.2, 5.4, 5.5, 5.6

Unit II Integral Calculus – Integration and Integration by Successive Reduction

Text: Integral Calculus, Santhi Narayanan and P.K. Mittal, S. Chand and Co.

Quick review of basics of Integration (*Questions should* ***not*** *be asked in the End Semester Examinations from the above sections for quick review*)

Sections 8.1, 8.2, 8.3, 8.4, 8.5

Integration of Trigonometric Functions: Integration of $sin^n x$, where *n* is a positive integer, evaluation of the definite integral $\int_0^{\frac{\pi}{2}} sin^n x\ dx$, Integration of $cos^n x$, evaluation of the definite integral $\int_0^{\frac{\pi}{2}} cos^n x\ dx$,Integration of $sin^p x cos^q x$,evaluation of the definite integral $\int_0^{\frac{\pi}{2}} sin^p x\ cos^q x dx$, integration of $tan^n x$, integration of $cot^n x$, integration of $sec^n x$, integration of $cosec^n x$

Sections 4.1, 4.1.1, 4.2, 4.2.1, 4.3, 4.3.1, 4.4.1, 4.4.2, 4.5.1, 4.5.2

Unit III Integral Calculus – Applications of Integration and Multiple Integrals

Text: Thomas' Calculus (12th edition), Maurice D. Weir and Joel Hass, Pearson India Education Services

Substitutions and the area between curves, arc length, Polar coordinates, areas and length in polar coordinates

Section 5.6, 6.3, 11.3, 11.5

Double and Iterated Integrals over rectangles, double integrals over general regions, area by double integration, double integrals in polar form, triple integrals in rectangular co-ordinates

Sections 15.1, 15.2, 15.3, 15.4, 15.5

Unit IV Linear Algebra - Eigen Values and Cayley-Hamilton Theorem

Text: Higher Engineering Mathematics (41st edition), B.S. Grewal

Eigen values, eigen vectors, properties of eigen values, Cayley- Hamilton theorem (without proof), reduction to diagonal form, similarity of matrices, powers of a matrix, reduction of quadratic form to canonical form, nature of a quadratic form

Sections 2.13, 2.14, 2.15, 2.16, 2.17, 2.18.

References

1. Differential and Integral Calculus, S. Narayanan and T.K.M. Pillay, S. Viswanathan Printers and Publishers, Chennai
2. Textbook of Matrices, Shanti Narayan and P.K. Mittal, S. Chand & Co.
3. Theory of and Problems of Matrices, Frank Ayres JR, Schaum's Outline Series, McGraw- Hill Book Company
4. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley
5. Calculus (10th edition), Anton, Bivens, Davis, Wiley-India

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	**Maximum Marks**
I	17	**40**
II	20	
III	17	
IV	12	
Total	**66**	

Pattern of Question Paper

Part A - **Short answer** (5 questions x Mark 1each = 5)
- ***Answer any 4 questions*** (4 *questions x Mark 1each = 4*)

Part B - **Short Essay** (10 questions x Marks 2 each = 20)
- ***Answer any 7 questions*** *(7 questions x Marks 2 each=14)*

Part C - **Essay** (7 questions x Marks 3 each = 21)
- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each = 20)
- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10).*

COMPLEMENTARY ELECTIVE COURSE 3:

MATHEMATICS FOR COMPUTER SCIENCE III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HOURS	MARKS		
					END SEM EXAM	INTERNAL	TOTAL
III	**3C03 MAT-CS**	**5**	**3**	**3**	**40**	**10**	**50**

COURSE OUTCOMES

CO1	Understand Ordinary differential equations, Geometrical meaning of $y'=f(x, y)$ and Direction Fields.
CO2	Understand Methods of solving Differential Equations: Separable ODEs, Exact ODEs, Integrating Factors, Linear ODEs and Bernoulli Equation.
CO3	Understand Orthogonal Trajectories, Existence and Uniqueness of Solutions.
CO4	Understand Second order ODEs, Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian, Non homogeneous ODEs and Solution by variation of Parameters
CO5	Understand Laplace Transform, Linearity, first shifting theorem, Transforms of Derivatives and Integrals, ODEs, Unit step Function, second shifting theorem, Convolution, Integral Equations, Differentiation and integration of Transforms and to solve special linear ODE's with variable coefficients and Systems of ODEs
CO6	Understand Fourier series, arbitrary period, Even and Odd functions, Half-range Expansions.
CO7	Understand Partial Differential Equations and to solve PDEs by separation of variables and by use of Fourier series.

3C03 MAT-CS: Mathematics for Computer Science III

Unit I First Order Ordinary Differential Equations
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, 2015
Basic concepts, Geometrical meaning of $y'=f(x, y)$. Direction Fields (numerical method by Euler excluded), Separable ODEs (modelling excluded) Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation (population dynamics excluded) Chapter 1 Sections 1.1, 1.2, 1.3, 1.4, 1.5

Unit II: Second Order Ordinary Differential Equations
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley, 2015
Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian (statement of Theorems only, proofs omitted), Non homogeneous ODEs, Solution by variation of Parameters.
Sections 2.1 to 2.10 *except* 2.4, 2.8 and 2.9

Unit III: Laplace Transforms and its Applications
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley
Laplace Transforms: Laplace Transform, Linearity, first shifting theorem (*s*-Shifting), Transforms of Derivatives and Integrals, ODEs, Unit step Function, second shifting theorem (*t*- Shifting), Convolution, Integral Equations, Differentiation and integration of Transforms, special linear ODE's with variable coefficients, Systems of ODEs, Laplace Transform, General Formulas, Table of Laplace Transforms.
Chapter 6 Sections 6.1, 6.2, 6.3, 6.5, 6.6, 6.7, 6.8, 6.9 (Proofs omitted)

Unit IV Fourier Series and Partial Differential Equations
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley
Fourier series, arbitrary period, Even and Odd functions, Half-range Expansions. (Proofs omitted)
Chapter 11 Sections 11.1, 11.2

Partial Differential Equations - Basic Concepts, solution by separation of variables, use of Fourier series Sections 12.1, 12.3

References

1. Higher Engineering Mathematics (41st edition), B .S. Grewal, Khanna Pub.

2. Elementary Differential Equations and Boundary Value Problems, W.E. Boyce and R.C. Deprima, Wiley
3. Differential Equations, S.L. Ross, Wiley
4. An Introduction to Ordinary Differential Equtions, E.A. Coddington, Printice Hall
5. A Textbook of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Pub.

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	**Maximum Marks**
I	18	**40**
II	15	
III	15	
IV	18	
Total	**66**	

Pattern of Question Paper

Part A - **Short answer** (5 questions x Mark 1each = 5)
- ***Answer any 4 questions*** (4 *questions x Mark 1each = 4*)

Part B - **Short Essay** (10 questions x Marks 2 each = 20)
- ***Answer any 7 questions*** *(7 questions x Marks 2 each=14)*

Part C - **Essay** (7 questions x Marks 3 each = 21)
- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each = 20)
- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10).*

COMPLEMENTARY COURSE 4:
MATHEMATICS FOR COMPUTER SCIENCE IV

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HOURS	MARKS		
					END SEM EXAM	INTERNAL	TOTAL
IV	**4C04 MAT-CS**	**5**	**3**	**3**	**40**	**10**	**50**

COURSE OUTCOMES

CO1	Understand the concept of a graph, graphs as models, vertex degrees, sub graphs, paths and cycles, matrix representation of graphs, trees and connectivity – definition and simple properties.
CO2	Understand Linear Programming Problems, their canonical and standard forms.
CO3	Understand Methods to solve LPP : Graphical solution method and Simplex method
CO4	Understand Transportation problems, transportation table, loops. Solve a Transportation Problem by finding an initial basic feasible solution and then by using the transportation algorithm known as MODI method.
CO5	Understand Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule
CO6	Understand Numerical methods to find Solutions of Ordinary Differential Equations: Solution by Taylor's series, Euler's method, Modified Euler's method, Runge-Kutta methods.

4C04 MAT-CS: Mathematics for Computer Science IV

Unit I

Text: A First Look at Graph Theory, John Clark and Derek Allan Holton, Allied Pub.

The definition of a graph, graphs as models, More definitions (problems on isomorphism excluded), vertex degrees, subgraphs, paths and cycles, matrix representation of graphs, trees and connectivity – definition and simple properties (Proofs of theorems 2.1, 2.2, 2.3, 2.5 and that of corollary 2.4 are excluded) (Problems involving proofs are excluded)

Sections 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1

Unit II Linear Programming

Text: Operations Research (18th thoroughly revised edition), Kantiswaroop, P.K. Gupta and Manmohan, Sultan Chand & Sons.

Mathematical formulation of daily life situations – simple cases only (Questions should be avoided for end semester examination from this topic)

Canonical and standard form, Graphical solution method, Simplex method – computational procedure (Proofs of theorems are excluded)

Sections 2.1, 2.2, 2.3, 2.4, 3.2, 4.3

Unit III Linear programming

Text: Operations Research (18th thoroughly revised edition), Kantiswaroop, P.K. Gupta and Manmohan, Sultan Chand & Sons.

Transportation problem – introduction, transportation table, loops, solution to a Transportation Problem, finding an initial basic feasible solution, transportation algorithm (MODI method)

(Proofs of theorems excluded)

Sections 10.5, 10.6, 10.8, 10.9, 10.13

Unit IV Numerical Analysis

Text: Introductory Methods of Numerical Analysis (fifth edition), S.S. Sastry PHI Learning

Numerical Integration-

Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule

Chapter 6 Sections 6.4, 6.4.1, 6.4.2

Numerical Solutions of Ordinary Differential Equations: Introduction, Solution by Taylor's series, Euler's method, Modified Euler's method, Runge-Kutta methods.

Sections 8.1, 8.2, 8.4, 8.4.2, 8.5

References

1. Introduction to Graph Theory, F. Harary, Narosa Pub.
2. Graph Theory with Applications, J.A. Bondy and U.S.R.Murty, Macmillan
3. Linear Programming, G. Hadley, Oxford & IBH Publishing Company, New Delhi.
4. Operations Research, S. Kalavathy, Vikas Pub.
5. Mathematical Methods, S. R. K. Iyengar and R. K. Jain, Narosa Pub.

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	Maximum Marks
I	16	**40**
II	18	
III	16	
IV	16	
Total	**66**	

Pattern of Question Paper

Part A - **Short answer** (5 questions x Mark 1each = 5)

- ***Answer any 4 questions*** (4 *questions x Mark 1each = 4*)

Part B - **Short Essay** (10 questions x Marks 2 each = 20)

- ***Answer any 7 questions*** *(7 questions x Marks 2 each=14)*

Part C - **Essay** (7 questions x Marks 3 each = 21)

- ***Answer any 4 questions*** *(4 questions x Marks 3 each=12)*

Part D - **Long Essay** (4 questions x Marks 5 each = 20)

- ***Answer any 2 questions*** *(2 questions x Marks 5 each=10).*