MATHEMATICS
COMPLEMENTARY ELECTIVE COURSES FOR BCA PROGRAMME

COMPLEMENTARY ELECTIVE COURSE 1:

MATHEMATICS FOR BCA I

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

COURSE OUTCOMES

CO 1	Understand differentiation, derivative of functions namely constant function, trigonometric function, inverse trigonometric functions, y = log x, hyperbolic functions and parametrically defined function, Logarithmic differentiation and derivative of implicitly defined functions.
CO 2	Understand Successive differentiation and Leibnitz's theorem for the nth derivative of the product of two functions.
CO 3	Understand Basics of Boolean Algebra: Definition, duality and basic theorems.
CO 4	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.
CO 5	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.
CO 6	Understand Linear transformations, orthogonal transformation and linear dependence of vectors.

1C01 MAT-BCA: Mathematics for BCA I

Unit I - Differential Calculus – Differentiation

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

Basics of differentiation – Derivative of a constant function, some general theorems on derivation (theorems without proof), derivatives of trigonometric functions, derivatives of inverse trigonometric functions, derivative of $y = \log x$, hyperbolic functions, derivation of parametrically defined functions, logarithmic differentiation, derivation of implicitly defined functions.

(Sections 4.2, 4.3 except 4.3.5, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10)

Unit II - Differential Calculus– Successive Differentiation

Text: Higher Engineering Mathemaics (41st 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 functions

(Sections 4.1, 4.2)

Unit III - Boolean Algebra

Text: Set Theory and Related Topics, S. Lipschitz, Schaum's Series

Introduction, basic definition, duality, basic theorems

(Sections 11.1, 11.2, 11.3, 11.4)

Unit IV - Linear Algebra - Matrices and System of Equations, Linear Transformations

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

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 2.7, 2.8,2.9, 2.10, 2.11, 2.12)

References

1. Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley
2. Calculus (10th edition), Anton, Bivens, Davis, Wiley-India
3. A Textbook of Matrices, Shanti Narayan and P.K. Mittal, S. Chand & Co

4. Higher Engineering Mathematics (41st edition), B.S. Grewal, Khanna Pub.
5. Theory of and Problems of Matrices, Frank Ayres JR, Schaum's Outline Series, McGraw- Hill Book Company

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	Maximum Marks
I	15	**40**
II	17	
III	13	
IV	21	
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 2:
MATHEMATICS FOR BCA II

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HOURS	MARKS		
					END SEM EXAM	INTERNAL	TOTAL
II	**2C02 MAT-BCA**	**4**	**4**	**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 basics of integration, Integration by parts, trigonometric integrals, trigonometric substitutions and integration of rational functions by partial fractions.
CO4	Understand Polar co-ordinates.
CO5	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 $\int_0^{\frac{\pi}{2}} sin^p x\, cos^q x dx$.
CO6	Understand Double and Iterated Integrals over rectangles, double integrals over general regions and triple integrals in rectangular co-ordinates.
CO7	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-BCA: Mathematics for BCA II

Unit I- Differential Calculus - Partial Differentiation

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

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

Basics of Integration – Integration by parts, trigonometric integrals, trigonometric substitutions, integration of rational functions by partial fractions

(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,

Integration of $sin^n x$, 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 $tan^n x$ (Derivation of formulae omitted)

(Sections 4.1, 4.1.1, 4.2, 4.2.1, 4.3, 4.3.1, 4.4.1)

Unit III Integral Calculus – Multiple Integrals

Text: Thomas' Calculus (12th edition), Maurice D. Weir and Joel Hass, Pearson India Education Services, 2016

Polar co-ordinates, Double and Iterated Integrals over rectangles, double integrals over general regions, triple integrals in rectangular co-ordinates

(Sections 11.3, 15.1, 15.2, 15.5)

Unit IV - Linear Algebra - Eigen Values and Cayley-Hamilton Theorem (22 hrs)

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. Calculus (10^{th} edition), Anton, Bivens, Davis, Wiley-India
3. A Textbook of Matrices, Shanti Narayan and P.K. Mittal, S. Chand & Co
4. Theory of and Problems of Matrices, Frank Ayres JR, Schaum's Outline Series, McGraw- Hill Book Company
5. Advanced Engineering Mathematics (10^{th} edition), E. Kreyszig, Wiley

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	Maximum Marks
I	16	**40**
II	16	
III	16	
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 ELECTIVE COURSE 3:
MATHEMATICS FOR BCA III

SEMESTER	COURSE CODE	HOURS PER WEEK	CREDIT	EXAM HOURS	MARKS		
					END SEM EXAM	INTERNAL	TOTAL
III	**3C03 MAT-BCA**	**4**	**4**	**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 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 and Nonhomogeneous ODEs.
CO4	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
CO5	Understand Fourier series, arbitrary period and Even and Odd functions

3C03 AMT-BCA: Mathematics for BCA III

UnitI - First Order Ordinary Differential Equations (22 hrs)
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley, 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
(Sections 1.1, 1.2, 1.3, 1.4, 1.5)

Unit II - Second Order Ordinary Differential Equations (16 hrs)
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, proof omitted), Nonhomogeneous ODEs.
(Sections 2.1 to 2.9 *except* 2.4, 2.8)

Unit III - Laplace Transforms and its Applications (20 hrs)
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley, 2015

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, Laplace Transform, General Formulas, Table of Laplace Transforms.
(Chapter 6 Sections 6.1, 6.2, 6.3, 6.5, 6.6, 6.8, 6.9 (Proofs omitted))

Unit IV Fourier Series (14 hours)
Text: Advanced Engineering Mathematics (10th edition), E. Kreyszig, Wiley, 2015

Fourier series, arbitrary period, Even and Odd functions.(Proofs omitted)
(Chapter 11 Sections 11.1, 11.2 (half range expansions excluded))

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	20	**40**
II	16	
III	16	
IV	14	
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 4:
MATHEMATICS FOR BCA IV

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

COURSE OUTCOMES

CO 1	Understand principle of counting, permutations, combinations, basic terminology.
CO 2	Understand the meaning of probability, probability and set notations, random experiment, sample space, event, axioms, notations, addition law of probability, theorem of total probability, independent events and multiplication law of probability
CO 3	Understand LPP, canonical and standard form, Graphical solution method, Simplex method and computational procedure.
CO 4	Understand Network routing problems: introduction, network flow problem, minimal spanning tree problem and shortest route problems.
CO 5	Understand Numerical Integration, Trapezoidal Rule and Simpson's 1/3-Rule.
CO 6	Understand Numerical methods to find Solutions of Ordinary Differential Equations: Solution by Euler's method and Runge-Kutta methods.
CO 7	Understand volumes of solid using cross sections and areas of surfaces of revolution

4C04 AMT-BCA: Mathematics for BCA IV

Unit I- Probability **(18 hours)**

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

Probabiliy – introduction, principle of counting, permutations, combinations, basic terminology, definition of probability, statistical definition of probability, probability and set notations, random experiment, sample space, event, axioms, notations, addition law of probability or theorem of total probability (proof excluded), independent events, multiplication law of probability.
(Sections 26.1, 26.2, 26.3, 26.4, 26.5)

Unit II- Linear Programming **(24 hours)**

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 section).*

Canonical and standard form, Graphical solution method, Simplex method – computational procedure (Proof of theorems excluded)
(Sections 2.1, 2.2, 2.3, 2.4, 3.2, 4.3)

Unit III - Linear programming **(14 hours)**

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

Network routing problems – introduction, network flow problem, minimal spanning tree problem, shortest route problems (algorithm omitted)
(Sections 24.1, 24.2, 24.3, 24.4)

Unit IV - Numerical Analysis **(16 hours)**
Text: Introductory Methods of Numerical Analysis (fifth edition), S.S. Sastri PHI Learning, 2015
Numerical Integration: Trapezoidal Rule, Simpson's 1/3- Rule
(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 Probablity and Statistics, S. Lipschutz, J. Schiller, Schaum's Outline series
2. Linear Programming, G. Hadley, Oxford & IBH Publishing Company, New Delhi.
3. Operations Research, S. Kalavathy, Vikas Pub.
4. Mathematical methods, S. R. K. Iyengar and R. K. Jain, Narosa Pub
5. Advanced Engineering Mathematics (10^{th} edition), E. Kreyszig, Wiley

Marks including choice

Unit	Marks in End Semester Examination	
	Aggregate Marks	Maximum Marks
I	16	**40**
II	20	
III	14	
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).*