SYLLABUS

FOR

B.Sc./B.A. Mathematics

Under

Credit and Grading System

DEPARTMENT OF MATHEMATICS
MIZORAM UNIVERSITY
AIZAWL – 796004

B.Sc/B.A. MATHEMATICS COURSE STRUCTURE FOR CREDIT & GRADING SYSTEM

Sem	Course/Paper No	Option	Name	Credit I	Credit F	Page No
I	MATH/1/CC/111		Calculus	6	6	5
II	MATH/2/CC/121		Algebra	6	6	6
III	MATH/3/CC/231		Differential Equations	6	6	7
IV	MATH/4/CC/241		Vector Calculus and Solid Geometry	6	6	8
V	MATH/5/CC/351		Computer Oriented Numerical Analysis	6	6	9
	MATH/5/CC/352		Real Analysis	6	6	10
	MATH/5/CC/353		Complex Analysis	6	6	11
	MATH/5/CC/354 A	A	Operations Research	6	6	12
	MATH/5/CC/354 B	B	Probability Theory	6		13
	MATH/5/CC/354 C	C	Computer Programming in Fortran (Theory)	4		14
	MATH/5/CC/354 CP	CP	Computer Programming in Fortran (Practical)	2		15
VI	MATH/6/CC/361		Modern Algebra	6	6	16
	MATH/6/CC/362		Advanced Calculus	6	6	17
	MATH/6/CC/363		Mechanics	6	6	18
	MATH/6/CC/364 A	A	Astronomy	6	6	19
	MATH/6/CC/364 B	B	Elementary Number Theory	6		20
	MATH/6/CC/364 C	C	Computer Programming in C (Theory)	4		21
	MATH/6/CC/364 CP	CP	Computer Programming in C (Practical)	2		22
			TOTAL		**72**	

I-Individual paper credit, **F** = Final credit

<u>KEY POINTS</u> :

1. Contact hour per lecture is 1 hour. For theory, 1 contact hour is 1 Credit and for practical, 2 contact hour is 1 credit.
2. Internal tests/Assignment will be conducted as a part of internal assessment as per CBCS regulations (UG) of Mizoram University.

<u>CORE AND ELECTIVE PAPERS</u> :

The permitted combinations for Mathematics Core are given below:

B.Sc/B.A. MATHEMATICS COURSE STRUCTURE FOR CREDIT & GRADING SYSTEM

Sem	Course/Paper No	Name	Credit				MARKS			Exam (hrs)
			L	T	P	TT	CA	End Sem	Total	
I	SC/1/FC/01	English-I	4	1	0	5	40	60	100	3
	MATH/1/CC/111	Calculus	5	1	0	6	40	60	100	3
	Elective Course 1	Theory				4	40	60	100	
		Practical				2	40	60	100	
	Elective Course 2	Theory				4	40	60	100	
		Practical				2	40	60	100	
		TOTAL				**23**	**240**	**360**	**600**	
II	SC/1/FC/02	English-II	4	1	0	5	40	60	100	3
	MATH/2/CC/121	Algebra	5	1	0	6	40	60	100	3
	Elective Course 1	*Theory*				4	40	60	100	
		Practical				2	40	60	100	
	Elective Course 2	*Theory*				4	40	60	100	
		Practical				2	40	60	100	
		TOTAL				**23**	**240**	**360**	**600**	
III	SC/1/FC/03	History of Science	4	1	0	5	40	60	100	3
	MATH/3/CC/231	Differential Equations	5	1	0	6	40	60	100	3
	Elective Course 1	*Theory*				4	40	60	100	
		Practical				2	40	60	100	
	Elective Course 2	*Theory*				4	40	60	100	
		Practical				2	40	60	100	
		TOTAL				**23**	**240**	**360**	**600**	
IV	SC/1/FC/04	Environmental Studies	4	1	0	5	40	60	100	3
	MATH/4/CC/241	Vector Calculus and Solid Geometry	5	1	0	6	40	60	100	3
	Elective Course 1	*Theory*				4	40	60	100	
		Practical				2	40	60	100	
	Elective Course 2	*Theory*				4	40	60	100	
		Practical				2	40	60	100	
		TOTAL				**23**	**240**	**360**	**600**	
V	MATH/5/CC/351	Computer Oriented Numerical Analysis	5	1	0	6	40	60	100	3
	MATH/5/CC/352	Real Analysis	5	1	0	6	40	60	100	3
	MATH/5/CC/353	Complex Analysis	5	1	0	6	40	60	100	3
		<u>Optional Paper I (any one)</u>								
	MATH/5/CC/354A	Operations Research	5	1	0	6	40	60	100	3
	MATH/5/CC/354B	Probability Theory	5	1	0	6	40	60	100	3

Sem	Course/Paper No	Name	Credit				MARKS			Exam (hrs)
			L	T	P	TT	CA	End Sem	Total	
V	MATH/5/CC/351	Computer Oriented Numerical Analysis	5	1	0	6	40	60	100	3
	MATH/5/CC/352	Real Analysis	5	1	0	6	40	60	100	3
	MATH/5/CC/353	Complex Analysis	5	1	0	6	40	60	100	3
		Optional Paper I (any one)								
	MATH/5/CC/354A	Operations Research	5	1	0	6	40	60	100	3
	MATH/5/CC/354B	Probability Theory	5	1	0	6	40	60	100	3
	MATH/5/CC/354C	Computer Programming in Fortran (Theory)	3	1	0	4	40	60	100	3
	MATH/5/CC/354CP	Computer Programming in Fortran (Practical)	0	0	2	2	40	60	100	2
		TOTAL				24	160/200	240/300	400/500	
VI	MATH/6/CC/361	Modern Algebra				6	40	60	100	3
	MATH/6/CC/362	Advanced Calculus				6	40	60	100	3
	MATH/6/CC/363	Mechanics				6	40	60	100	3
		Optional Paper II (any one)								
	MATH/6/CC/364A	Astronomy	5	1	0	6	40	60	100	3
	MATH/6/CC/364B	Elementary Number Theo	5	1	0	6	40	60	100	3
	MATH/6/CC/364C	Computer Programming in C (Theory)	3	1	0	4	40	60	100	3
	MATH/6/CC/364CP	Computer Programming in C (Practical)	0	0	2	2	40	60	100	2
		TOTAL				24	160/200	240/300	400/500	
		GRAND TOTAL				140	1360 or 1400 or 1440	2040 or 2100 or 2160	3400 or 3500 or 3600	

L- Lecture, T - Tutorial, P - Practical, TT - Total

EXAMINATION PATTERN :

1. Internal tests as per CAGP guidelines for UG (MZU).
2. The following will be mark distribution and question pattern :

2.1 All paper (Except MATH/5/CC/354C, 354CP and MATH/6/CC/364C, 364CP)

Duration of Examination : 3 Hours

Section	Total No. of Questions	No. of questions to be answered	Marks for Each Question	Total Marks
A. Objective/ multiple Choice	10 (two questions from each unit)	10	1	10
B. Short Answer type	10 (two questions from each unit)	5 (one from each unit)	3	15
C. Descriptive (one out of two questions from each unit)	10 (two questions from each unit)	5 (one from each unit)	7	35
Total				60

2.2 Open Elective Papers(MATH/2/OE/122A,122B and MATH/3/OE/232A, 232B)

Duration of Examination : 2 Hours

As per common pattern from MZU

2.3 For MATH/5/CC/354C and MATH/6/CC/364C

Duration of Examination : 3 Hours

Section	Total No. of Questions	No. of questions to be answered	Marks for Each Question	Total Marks
A. Objective/ multiple Choice	8 (2 questions from each unit)	8	1	8
B. Short Answer type	8 (2 questions from each unit)	4(1 from each unit)	3	12
C. Descriptive two from each unit)	8 (2 questions from each unit)	4 (1 from each unit)	10	40
Total				60

2.4. For MATH/5/CC/354CP and MATH/6/CC/364CP – END SEMESTER PRACTICALS

Duration : 3 hours

Q.1. Experiment 1	Procedure/Performing of the experiment	15
	Results and discussion	5
Q. 2. Experiment 2	Procedure/Performing of the experiment	15
	Results and discussion	5
Q. 3.	Viva Voce	10
Q. 4.	Record	10
	Total	**60**

(Note : Internal Practical as per CAGP Guideline for UGC (MZU))

3. Scheme of awarding Marks in internal assessment (As per MZU guideline)

Theory	**Item**	**Mark**
	Class tests (Best two out of three)	20
	Assisgnment (Minimum two)	15
	Regularity in the class	5
	Total	40

Practical	**Item**	**Mark**
	Evaluation in the lab record	15
	End Semester test	20
	Regularity in the class	5
	Total	40

Attendance Evaluation for each course

Attendance	**Mark**
90% and above	5
85 to 89.9%	4
80 to 84.9%	3
76 to 79.9%	2
75 to 75.9%	1

FIRST SEMESTER

CALCULUS

Coure/Paper No : MATH/1/CC/111

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : *Functions and graphs* of real valued functions; definition of limit, standard theorems on limits, *continuity*: L'Hospital's Rule (statements only with applications), Derivatives of real valued functions on intervals: definition; derivative as a rate of measure, derivative as the gradient of tangent; successive differentiation; Leibnitz's theorem.

UNIT II : Sign of the derivatives of a real valued function of a real variable: vanishing of f(x); Rolle's theorem; geometric interpretation, mean value theorems; applications of the mean value theorems: Taylor's and Maclaurin's theorem with Cauchy's form of remainders; Taylor's and Maclaurin's series; expansion of standard functions such as e^x*, sinx, cosx,log (1+x),*.

UNIT III : *Anti-derivative* : examples of evaluation of integrals from the definition; statements with illustration of the following two results; fundamental theorem of integral calculus; differentiability of integrals of continuous functions; properties of definite integral, evaluation of integrals using these properties; reduction formulas for , , and their combinations.

UNIT IV : *Real-valued functions of two or three variables*: limits; continuity; partial derivatives of first and second orders; Schwarz's theorem (statement only); differentials; chain rules; Euler's theorem on homogeneous functions, proof upto three variable case; evaluation of line integrals (in a plane); double integrals; change of order of integration; application in determination of area, volume (simple cases only).

UNIT V : Sequences of real numbers: definitions of bounded sequence, convergent sequence, limit of a sequence, monotonic sequence; examples; proof of the fact that monotonic and bounded sequences are convergent (using completeness of R as an axiom); Cauchy sequence; Cauchy's general principle of convergence; infinite series of real numbers: partial sums, convergent series, comparison test, ratio test, Raabe's test.

***Text Books*:**

1. Das, B.C. & Mukherjee, B.N. : Differential Calculus, U.N. Dhur & Sons (P) Ltd. (For Unit I and II)
2. Das, B.C. & Mukherjee, B.N. : Integral Calculus, U.N. Dhur & Sons (P) Ltd. (For Unit III and IV)

3.Malik and Arora : Mathematical Analysis (for Unit V)

References :

1. Maity, K. C. and Ghosh, R. K. : Differential Calculus, New Cental Book Agency Pvt Ltd., 2001 Ed.

2. Maity, K. C. and Ghosh, R. K. : Integral Calculus, New Cental Book Agency Pvt Ltd., 2002 Ed.

SECOND SEMESTER

ALGEBRA

Coure/Paper No : MATH/2/CC/121

Marks : 100 *6 Credits*

(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Binary operations, examples; groups: definition; detailed study of groups such as Z, Q, R, C, S_n, M_2(R), GL_2(R), n^{lh} roots of unity; cancellation laws; uniqueness of identity and inverses; group tables of groups of low order (up to 4); abelian groups; cyclic subgroup generated by an element; cyclic group; subgroups of cyclic groups; determination of all subgroups of Z; order of an element; coset of a subgroup; cosets as equivalence classes; Z_n as cosets.

UNIT II : Lagrange's theorem and its applications; groups of prime order; Fermat's (little) theorem; Euler's generalizations; application to simple number theoretic problems; homomorphism, kernel and image of homomorphism, isomorphism of groups.

UNIT III : Example and elementary properties of Polynomials over Z / Q / R / C ; addition and multiplication; degree of a polynomial; degree of sum and product of polynomials; the division algorithm; remainder theorem.The study of roots of cubic, biquadratic equations; simple tests of irreducibility of polynomials with rational / integer coefficients.

UNIT IV : Detailed study of roots of a polynomial with real coefficients: immediate consequence of the fundamental theorem of algebra; multiple roots, common roots, complex roots, surd roots; Descartes' rule of signs - simple applications; location of roots using Rolle's theorem.

UNIT V : Relation between roots and coefficients of a polynomial; symmetric function of roots; formation of equation with given roots. De Moivre's theorem - application to solution of equation, expansion of cos n, sin n and tan n. Solution of a cubic and biquadratic equations by Cardan's method.

***Text Books*:**

1. Vasishtha A.R. : Modern Algebra, Krishna Prakashan Media (P) Ltd. Meerut. (for Unit I and II)
2. Das B.: Higher Algebra, Ashok Prakashan, Kolkata (for Unit III, IV and V)

References :

1. Singh, Shaligram : A text book of set theory, Bharati Bhawan Publishers, 1994 Edition.
2. Bhattacharya, P. B., Jain, S. K., and Nagpaul, S. R. : First Course in Linear Algebra (Wiley Eastern), 2001 Edition.
3. Rao,A.R., Karan, Bhimasum:Linear Algebra and its application, TRIM series; Hisdustan Pub., N. Delhi.
4. Fraleigh, John B. : A First Course in Abstract Algebra (Narosa Publishing House), 1999 Edition.

THIRD SEMESTER

DIFFERENTIAL EQUATIONS

Coure/Paper No : MATH/3/CC/231

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Formation of differential equations; equations of first order and first degree; solutions by separation of variables, by substitution; homogeneous equations; linear equations; Bernoulli's equation; exact equations; reduction to exact form by integrating factors.

UNIT II : Linear equations of second and third order with constant coefficients - complementary functions and particular integrals for , , , *;* equations of type .

UNIT III : Differential equations of first order but higher degrees; Clairut's equation and singular solution; geometrical interpretation; applications of first order differential equations to geometric and physical problems (simple cases), orthogonal trajectories.

UNIT IV : Linear differential equations of second order with variable coefficients; homogeneous equations; exact equations; transformation of the equation by changing the dependent variable/the independent variable, method of variation of parameters; simultaneous equations; total differential equation Pdx + Qdy +Rdz = 0.

UNIT V : Partial differential equation of first order, origin of first order equation, linear equations of first order, Lagrange's methods, integral surfaces passing through a given curve, orthogonal surfaces, non-linear equations of first order, Cauchy's method of characteristic, compatible systems of first order equations, Charpit's method.

***Text Books*:**

1. Raisinghania, M.D. : Ordinary and Partial Differential Equations. (S. Chand & Co. Ltd., New Delhi), 2002 Edition.

References :

1. Coddington, Earl A. : An Introduction to Ordinary Differential Equations (Prentice-Hall, India), 1998 Edition.
2. Piaggio, I. : An Elementary Treatise on Differential Equations and Applications (G. Bell & Sons), 2000 Edition.
3. Sneddon, I. N. : Elements of Partial Differential Equation (McGraw Hill). International Edition 1957.

FOURTH SEMESTER

VECTOR CALCULUS AND SOLID GEOMETRY

Coure/Paper No : MATH/4/CC/241

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Products (scalar and vector products) of vectors : properties and geometrical applications; arc length, unit tangent vector; curvature, normal vector; derivatives of scalar and vector products, tangential and normal components of acceleration.

UNIT II : Directional derivatives, gradient of a scalar- valued function, tangent planes; vector fields, curl and divergence of a vector field, surface integrals, surface integral for flux, line integrals and work, Stokes' theorem and Gauss' divergence theorem (statements and applications only).

UNIT III : Change of axes - invariants; pairs of straight lines; general equation of second degree; the standard form; reduction of the general equation to standard form; conditions for different conics; general conics : equations of tangents, normals, pairs of tangents, chord of contact, chord in terms of middle points, polar equation of plane curves.

UNIT IV : Space co-ordinates: rectangular, cartesian, cylindrical, spherical, angle between two planes; perpendicular distance of a point from a plane; bisectors of two planes; equations of straight lines in space; co-planarity of two straight lines; perpendicular distance of a point from a straight line; shortest distance between two straight lines in space

UNIT V : Sphere - plane section and its equation; sphere through a given circle; tangent plane; pole and polar plane; intersection of two spheres; radical plane; equation of a cone with a conic as a guiding curve; enveloping cone; mutually perpendicular generators; tangent planes; reciprocal cone; right circular cone; equation of a cylinder with a conic as a guiding curve; right circular cylinder.

***Text Books*:**

1. Spiegel Murray : Vector Calculus, Tata McGrow Hill (Unit I & II)
2. Das, B. : Analytical Geometry and vector Analysis (Orient Book Co., Calcutta), 1998 Edition. (For Unit III, IV & V)

References :

1. Ghosh, R. K. and Maity, K. C: Vector Analysis(New Central Book Agency), 2001 Edition.
2. Shanti Narayan : Analytical Solid Geometry (S. Chand & Co., New Delhi), 2003 Edition.
3. Loney, S. L. : The Elements of Coordinate Geometry, (S. Chand & Co., New Delhi).
4. Shanti Narayan, and Mittal, P. K.: A Text Book of Vector Analysis (S. Chand & Co. Ltd., New Delhi), 2003 Edition.

FIFTH SEMESTER

COMPUTER ORIENTED NUMERICAL ANALYSIS

Coure/Paper No : MATH/5/CC/351

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Difference operators and relation between them, differences of a polynomial, factorial polynomials.Solutions of algebraic and Trancendental equations, Bisection method, Iteration method, Regula falsi method, Newton-Raphson method.

UNIT II : Difference tables : forward difference, backward difference, Divided difference; Newton's forward and backward interpolation formulae, Newton's divided differences formula for interpolation, Lagrange's interpolation polynomials.

UNIT III : Solution of system of linear equations, Gauss elimination method, Gauss-Jordan method, Gauss-Siedel method, Crout's method.

UNIT IV : Numerical differentiation and integration, trapezoidal rule, Simpson's 1/3rd rule.

UNIT V : Numerical solution of differential equations - Taylor series method, Picard's method, single and multistep method, Euler's method, Runge-Kutta methods (up to fourth order), predictor-corrector method (Milne's Method).

***Text Books*:**

1. Rajaraman, V. : Computer Oriented Numerical Methods (Prentice-Hall of India Pvt. Ltd., New Delhi), 2002 Edition.

References :

1. Jain, M. K., Iyenger, S. R. K., Jain, R. K.: Numerical Methods (Problems and solutions) Wiley Eastern Ltd., (New Age International Publishers Ltd.) 1995 Edition.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K. : Numerical Methods, (S. Chand & Co. Ltd., New Delhi), 2003 Edition.
3. Calculus of finite differences and Numerical analysis by Saxena, S Chand & Co.

FIFTH SEMESTER

REAL ANALYSIS

Coure/Paper No : MATH/5/CC/352

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Basic properties of Euclidean distance function in R^n; neighbourhoods, open sets, closed sets, limit points, interior points in R^n (n = 1, 2, 3); Bolzano-Weierstrass theorem (n dimension); Cantor intersection theorem (nested interval) Lindelof covering theorem (Statement only), compact sets; Heine-Borel theorem.

UNIT II : Metric spaces: Introduction to metric spaces, open set, closed set, closure, interior of a set in metric space, neighbourhood, complete metric space with examples, compact set, basic properties of compact set - compact subset of a metric space is closed, closed subset of a compact sets are compact.

UNIT III : Real valued function of several variables: Continuity, elementary properties of continuous functions; continuous functions on compact sets; special cases of continuous real valued functions on closed, bounded intervals of R: bounds; intermediate value theorem; uniform continuity.

UNIT IV : Partial derivatives of a real valued function with domain up to R^3; existence of directional derivatives; mean value theorem; derivability of composites, differentiability at a point, condition for differentiability, Jacobians and their properties.

UNIT V : Reversal of order of derivatives, Schwarz's theorem, Young's theorem, Taylor's theorem, extreme values of a function, necessary condition for extreme value, sufficient condition for extreme value(for function of two variables).

***Text Books*:**

1. Malik and Arora : Mathematical Analysis, New Age international (P) Ltd.
2. Shanti Narayan: A Course of Mathematical Analysis (S. Chand. Delhi), 2003 Edition.

References :

1. Apostol, Tom A. : Mathematical Analysis (Narosa Publishing House), 2002 Edition
2. Apostol, Tom M. : Calculus II
3. Bartle, R.G., and Sherbert, D.R. : Introduction to Real Analysis (John Wiley & Sons, Inc.), 2000 Edition.

FIFTH SEMESTER

COMPLEX ANALYSIS

Coure/Paper No : MATH/5/CC/353

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Complex numbers; conjugate: basic properties; real and imaginary parts; identification of the plane with the complex numbers; distance function (in terms of the absolute value); triangle inequality, parallelogram law; related inequalities; polar representation; magnitude, argument; geometry of complex numbers: straight lines, circles in terms of complex numbers, equation of circle through three points; spherical representation.

UNIT II : Analytic function; basic properties; analyticity of power series; power series definition of (complex) exponential function, sine, cosine function; branch of a logarithm; principal branch of a power function for complex; Necessary and sufficient condition for analyticity in terms of Cauchy-Riemann equations.

UNIT III : Power series; absolute convergence, univorm convergence, circle of convergence, Cauchy-Hadamard formula for the radius of convergence; ratio test.

UNIT IV : Integration of complex valued function along a "piece-wise differentiable" curve (using real integral for real and imaginary parts); basic properties; (including inequalities); Cauchy's theorem for disc, Cauchy's integral formula for disc.

UNIT V : Power series representation of analytic functions; Cauchy's estimate; Liouville's theorem, fundamental theorem of algebra; zeroes of an analytic function: related results; maximum modulus theorem.

***Text Books*:**

1. Ponnusamy, S.: Complex Analysis (Narosa Publishing House), 2002 Edition.
2. Goyal, J.K., Gupta, K.P. and Pundir, S.K.: Complex Analysis (Pragati Prakashan), 2012 Edition.

References :

1. Shanti Narayan : Theory of a complex variable (S. Chand & Co.; Delhi), 2001 Edition.
2. Alforhs, L. V. : Complex Analysis (McGraw Hill Publications),1979 Inter national Edition (for the definition of integrals and properties in UNIT III)
3. Conway, J.: Functions of one Complex Variable (Narosa Publishing House), 2000 Edition.
4. Shastri, A. R. : An Introduction To Complex Analysis (Macmillan India Ltd.), 2003 Edition.

FIFTH SEMESTER

OPTIONAL

OPERATIONS RESEARCH

Coure/Paper No : MATH/5/CC/354A
Marks : 100 6
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Definition and scope of operations research, theorem on linear function which attains its optimum values at the vertices of a convex polygon, linear programming problem, mathematical formulation, graphical method of solution.

UNIT II : Simplex method of solution, minimax theorem, initial simplex table, terminal simplex table, pivot entry, algorithm of simplex method.

UNIT III : Duality in linear programming problem, assignment problems, transportation problem

UNIT IV : Integer programming, Branch bound technique, All integer programming problems and mixed integer programming problem

UNIT V : Theory of games, two person zero-sum games, the maximin-minimax principle, saddle point, relation between minimax and maximin game without saddle point, pure and mixed strategies, dominance property, modified dominance property, reduction of game to linear programming problem and its solution.

***Text Books*:**

1. Swarup, K., Gupta, P.K. and Singh, M.M. : Operations Research (Sultan Chand & Sons, New Delhi), 2002 Edition.

References :

1. Gupta, P.K. and Hira, D.S. : Operations Research-An introduction (Sultan Chand & Sons, New Delhi), 2002 Edition.
2. Rao, S.S. : Optimisation theory and Applications (Wiley Eastern Ltd., New Delhi), 2001 Edition
3. Maulik, T.N. : Linear programming, (U.N. Dhar & Sons Publications, Kolkata), 2001 Edition.

FIFTH SEMESTER

OPTIONAL

PROBABILITY THEORY

Coure/Paper No : MATH/5/CC/354B

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Random experiments, sample space, events, finite sample spaces, equally likely outcomes, axiomatic definition of probability, Baye's theorem, simple problem, independent events.

UNIT II : One-dimentional random variables, discrete random variables, binomial distribution, continuous random variables, uniformly distributed random variables, commulative distribution functions.

UNIT III : Two-dimentional random variables, marginal and conditional probability distribution, independent random variables, distribution of product and quotient of independent random variables.

UNIT IV : Expected value of a random variable, properties of expected value, variance of a random variable, properties of variance of a random variable, Chebyshev's inequality, simple problems, correlation coefficient, regression of the mean.

UNIT V : Poisson distribution, poisson distribution as an approximation of the to the binomial distribution. The Poisson process, geometric distribution, normal distribution, properties of the normal distribution, tabulation of the normal distribution, exponential and gamma distribution and their properties, moments(up to 4^{th} order), moment generating functions and their properties.

***Text Books*:**

1. Mayer, P.L. : Introductory Probability and Statistical Applications, 2^{nd} Edition, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

References :

1. Mukherjee, K.K. : Probability and Statistics (New Central Book Agency Pvt. Ltd.), 1993 Edition.
2. Chandra, T.K. : Probability Theory, Narosa Publishing House
3. Feller, W. : An introduction to Probability theory and its applications, Vol I, Third U.S. Edition(1968), Wiley Eastern Limited, New Delhi.

FIFTH SEMESTER

OPTIONAL

COMPUTER PROGRAMMING IN FORTRAN (THEORY)

Coure/Paper No : MATH/5/CC/354C

Marks : 100 *4*
Credits
(CA:40, End Sem:60) *(3-1-0)*

UNIT I : Flowcharts, Algorithms - definitions and characteristics; Euclid's algorithm for gcd; FORTRAN fundamentals - characters, variables, variable names, syntax, statements, constants, variables and expressions; names, types, evaluation of expressions. Input-output statements : unformatted and formatted input - output; integers, reals, complex, double precision, logical variables, alphanumeric information, data statements.

UNIT II : Unconditional, computed; assigned GO TO statement. Branches and loops - IF and DO statements; nesting of DO loops.

UNIT III : Arrays DIMENSION statement, Order of storage; equivalent statements; input and output of arrays; implied DO notation; subprograms.

UNIT IV : Functions and subroutines, functions and their references; statement function; subroutines call and return statements; common statements; library functions.

***Text Books*:**

1. Rajaraman, V.: Computer Programming with Fortran 77
   (Tata McGraw Hill Publishing Company), 2002 Edition.

References :

1. Gupta, V. K.: Computer Programming in Fortran IV (Pragati Prakashan, Meerut), 1988 Edition.
2. Ram Kumar: Programming with Fortran 77
   (Tata McGraw Hill Publishing Company), 2002 Edition.

FIFTH SEMESTER

OPTIONAL

COMPUTER PROGRAMMING IN FORTRAN (PRACTICALS)

Coure/Paper No : MATH/5/CC/354CP

Marks : 100 *2*
Credits
(CA:40, End Sem:60) *(0-0-2)*
(Time:3 hrs; Marks : 20) Practice the following programs.

1. Evaluation of roots of quadratic equations
2. Arranging given set of numbers in increasing/decreasing order, calculation of Mean
3. Evaluation of sum of power series eg. e^x, sin x, cos x, log (1 + x)
4. Calculation of HCF/LCM of two integers
5. Evaluation of factorials and binomial coefficients
6. Sieve method for primality test
7. Generation of twin primes
8. To find product of two polynomials.
9. Evaluation Legendre polynomial from recurrence relation
10. Solving simple/algebraic/transcendental equations; Newton's method (real roots only),
11. Matrix operations : sums and products,
12. Transpose, determinant (up to order 4),
13. Inversion of real matrices (up to order 4).

NOTE : There will be practical examination of three hours in which a candidate has to do two programs.

SIXTH SEMESTER

MODERN ALGEBRA

Coure/Paper No : MATH/6/CC/361

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Normal subgroups, examples; conditions for a subgroup to be normal; center of a group; examples; quotient group; fundamental theorem of group homomorphism; isomorphism theorems; automorphisms; inner automorphisms; examples.

UNIT II :Basic properties of rings; characteristic of rings; finite integral domains; (Zp as an example); subrings; ideals: right, left and two-sided; generated by a subset, more specifically by a finite number of elements in a commutative ring with 1; principal ideals; examples of ideals in Z, Z_n, $M_n(R)$; prime ideals, maximal ideals in a commutative ring with 1; examples; quotient ring, Z_n as a quotient ring, fields : Q, R, C.

UNIT III : Ring homomorphisms; kernels; isomorphism; homomorphisms and isomorphism theorems including the correspondence theorem; determination of ideals in Z_p ; divisibility in integral domains; units, associates, prime elements, irreducible elements, gcd, Euclidean domain, principal ideal domain, unique factorisation domains - definition, examples and basic results.

UNIT IV : Vector spaces : examples, basic properties; subspaces; homomorphisms or linear maps between vector spaces; isomorphisms; standard homomorphism and isomorphism theorems; . direct sum (internal and external); linear dependence and independence; basis, dimension.

UNIT V : Vector space axioms for the set L(V, W) of linear maps from V to W; algebra axioms for L(V, V); dual space; statement of the vector space property of M_{mxn} (F). The matrix of a linear transformation in L(V, W); similar matrices, change of basis theorem; rank and nullity of a linear transformation; rank - nullity theorem; equality of rank of a linear transformation and rank of the associated matrix.

***Text Books*:**

1. Vasishtha A.R. : Modern Algebra, Krishna Prakashan Media (P) Ltd. Meerut. (for Unit I, II and III)
2. Gupta K.P. : Linear Algebra, Pragati Prakashan, Meerut (Unit IV & V)

References :

1. Herstein, I. N. : Topics in Algebra (Vikas Pub. House), 1988 Edition (reprint 1998).
2. Fraleigh, J. B. : A First Course in Abstract Algebra. (Narosa Publishing House), 1999 Edition.
3. Hoffman, K. and Kunze, R. : Linear Algebra, second edition, Prentice-Hall, Eglewood Cliffs, New Jersy, 1971 Edition (reprint 1996).

SIXTH SEMESTER

ADVANCED CALCULUS

Coure/Paper No : MATH/6/CC/362

Marks : 100 *6*
Credits

(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Riemann integral of functions of one variable; Darboux's theorem; conditions for integrability; classes of bounded and integrable functions; properties of integrable functions; inequalities for integrals; functions defined by integrals; their continuity and differentiability; mean value theorems for integrals.

UNIT II : Improper integrals; test for convergence when the integrand is non-negative; absolute convergence; tests for absolute and conditional convergence, beta and gamma functions; Abel's theorem, Dirichlet's theorem; Frullani's integral. Proof of Fundamental theorem of Integral Calculus.

UNIT III : Integrals as functions of parameters; continuity, differentiability and integrability of such a function; applications to evaluation of integrals, improper integrals as functions of a parameter; uniform convergence and tests for uniform convergence; continuity, differentiability and integrability of uniformly convergent improper integrals of continuous functions involving parameters.

UNIT IV : Evaluation of integrals; line integral in R^2; evaluation of double integrals - change of order of integration; change of variable.

UNIT V : Sequences of (real valued) functions: pointwise and uniform convergence; properties of uniformly convergent sequences of functions; series of functions; uniform convergence, tests for uniform convergence; properties; term by term integration and differentiation of power series.

***Text Books*:**

1. Shanti Narayan : A Course of Mathematical Analysis. (S. Chand and Co., Delhi), 2003 Edition.

References :

1. Apostol, T. A.: Mathematical Analysis (Narosa Publishing House), 2002 Edition.
2. Rudin, W. : Principles of Mathematical Analysis (Me Graw - Hill Publications), International Editions 1976 (Reprint 1996).
3. Malik, S. C. and Arora, S.: Mathematical Analysis (New Age International (P) Ltd., Publishers) 1992 Edition (Reprint 2001).

SIXTH SEMESTER

MECHANICS

Coure/Paper No : MATH/6/CC/363

Marks : 100 *6*
Credits

(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Coplanar forces : reduction of coplanar forces; equilibrium of coplanar forces; general condition of equilibrium of any system of coplanar forces; friction: laws of statical friction; laws of limiting friction; coefficient of friction, angle of friction, cone of friction.

UNIT II : Centre of gravity of thin uniform rod; uniform lamina, triangular lamina and lamina in the form of a parallelogram; centre of gravity of circular arcs; of uniform sector of a circle; moments and products of inertia; theorems of parallel and perpendicular axes.

UNIT III : Motion in a straight line **-** Velocity and acceleration, Motion in a plane **-** Velocity and acceleration, Radial and tranverse velocities and acceleration, angular velocity and acceleration, Tangential and normal acceleration, relative motion, rectilinear motion ; motion in straight line with constant acceleration, simple harmonic motion.

UNIT IV : Uniplanar motion; Projectiles; projectile to pass through a given point, range on an inclined plane, envelope of the path, motion of a particle in resisting medium whose resistance varies as (i) velocity (ii) square of velocity.

UNIT V : Work done by a force; work energy equation, potential function; conservative forces, Impact; Action between two elastic bodies during the period of impact, Direct impact; direct impact of a smooth sphere on a fixed smooth plane, two smooth spheres colliding against each other, Oblique impact, oblique impact of a perfectly smooth sphere on a perfectly smooth fixed plane, oblique impact of two spheres.

***Text Books*:**

1. Das, B. C. and Mukherjee, B. N. : Statics (U. N. Dhar & Sons Publications, Kolkata), 2002 Edition.(Unit I and II)
2. Gupta, P. K., and Juneja, R. : Dynamics (Ramesh Book Depot, Jaipur), 2003 Edition.(Unit III, IV and V)

References :

1. Ray, M.: A Text Book on Dynamics for B.A./B.Sc. students (S. Chand Publication, Delhi), 2002 Edition.
2. Loney, S. L. : An elementary treatise on the Dynamics of a particle and of rigid bodies (Rahda publishing House, Kolkata), 2000 Edition.
3. Varma, R. S.: Statics (Pothishala, Allahabad), 2001 Edition.
4. Loney, S. L.: An elementary treatise on Statics

SIXTH SEMESTER

OPTIONAL

ASTRONOMY

Coure/Paper No : MATH/6/CC/364A

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Spherical Trigonometry : Section of a sphere by a plane, great and small circle, spherical triangles; formula for spherical trigonometry. Solution of spherical triangle; position of a point of a sphere.

UNIT II : The celestial sphere : Definition, Annual motion of the sun, system of coordinates, Hour angle, conversion of coordinates from one system to another, equinoxes and solstices, rising and setting of stars, rate of change of zenith distance and azimuth , motion of the sun, twilight.

UNIT III : Atmospheric refraction, sidereal time and mean time, correction of time, equation of time; seasons, geocentric parallax, stellar paralax, effects on right ascension, declination, longitude and latitude, paralactic eclipse; aberation, eclipses.

UNIT IV : Sidereal period and synodic periods of planet; direct and retrograde motions of planets, stationery points, phases of the planets and the moon; brightness of planets.

UNIT V : Kepler's laws, deduction of Kepler's laws from Newton's law of gravitation, apparent solar motion, sign of the Zodiac, dip of the horizon, The position circle.

***Text Books*:**

1. Dey, K.K. : Astronomy (Book Syndicate Pvt. Ltd., Kolkata), 2001 Edition

References :

1. Todhunter, I. : Spherical Trigonometry (Macmillan Publishing Co), 1996 Edition
2. Kar, J.M. : Astronomy (K.P.Basu Publishing Co.), 2001 Edition.

SIXTH SEMESTER

OPTIONAL

ELEMENTARY NUMBER THEORY

Coure/Paper No : MATH/6/CC/364B

Marks : 100 *6*
Credits
(CA:40, End Sem:60) *(5-1-0)*

UNIT I : Divisibility in the set of integers; basic properties; the division algorithm; gcd; elementary properties; the Euclidean algorithm; lcm; primes (in the set of natural numbers); fundamental theorem of arithmetic.

UNIT II: Euclid's proof of the infinitude of primes; arbitrary gaps in the distribution of primes; congruences in the set of integers modulo a positive integer; basic properties; complete residue system; reduced residue system.

UNIT III: Euler's - function; Fermat's theorem; Euler's generalization of Fermat's theorem; applications; Wilson's theorem, Lagrange's theorem, Primitive roots.

UNIT IV: Lagendre's symbols, Euler's Criterion, Gauss Lemma, Law of Quadratic Reciprocity, solution of congruences; linear congruences; Chinese remainder theorem; congruences of higher degree modulo a prime.

UNIT IV: Greatest integer function; elementary properties; arithmetic functions; multiplicative functions; functions such as ; Inversion formula; solutions of
(i) Linear Diophantine equation. (ii) Pythagorean equation.

Text Books -

1. Niven, I., Zuckerman, H.S., and Montgomery, H. L. :
   An introduction to the Theory of Numbers
   (Wiley Eastern Ltd.), 2000 Edition.
2. Burton, David M. : Elementary Number Theory
   (Universal Book Stall), 2001 Edition.

Reference Books -

1. Telang, S. G.. : Number Theory (Tata McGraw-Hill, New Delhi), 1996 Edition.
2. Malik S. B. : Basic Number Theory, Vikas Publishing House, 2nd Edition, 1998.

SIXTH SEMESTER

OPTIONAL

COMPUTER PROGRAMMING IN C (THEORY)

Coure/Paper No : MATH/6/CC/364C

Marks : 100
4Credits

(CA:40, End Sem:60) *(3-1-0)*

UNIT I : C fundamentals: The C character set, identifiers and keywords, Data types, constants, variables and arrays, declarations, symbolic constants, Operators (Arithmetic, unary, relational, logical, bitwise, assignment), expressions, statements, C program structure, Need of header files, Process of compiling and running a C program.

UNIT II :I/O functions: Header files (stdio.h, conio.h) getch(), getche(), getchar(), putch(), putchar(), scanf(), printf(), gets(), puts(), clrscr(), window(); Control statements: Decision making and branching (if. .else, switch), Decision making and looping (while, do .. while, for), Jumping (break, continue, goto), Nested loops; Functions: Overview (definition, declaration), defining a function, accessing a function, function prototypes, call by value, call by reference, recursion, iteration, Advantages and disadvantages of recursion over iteration.

UNIT III : Storage classes (Automatic, Register, External, Static), String functions (strcmp (), strlen (), strrev(), strcat (), toupper (), tolower ()), Math functions (sqrt (), abs (), sin (), cos (), Standard function- exit (), Memory allocation functions (malloc (), free (), realloc(), calloc()). Arrays and Pointers: Defining an array, array initialization, processing an array, passing array to a function, multidimensional arrays, arrays and strings, pointer declarations, passing pointer to a function, pointer and one dimensional arrays. Operation on pointers, pointers and multidimensional arrays, arrays of pointers, functions returning pointers.

UNIT IV : Structures and Unions: Defining a structure, processing a structure, user defined data types, structures and arrays, structures and pointers, passing structures to a function, self referential structures, Union, Union of structures, Enumerated, typedef. Data files: File opening modes, character I/O (getc(), putc()), String I/O (fgets(), fputs()), Formatted console I/O (fscanf(), fprintf()), text mode versus binary mode, Unformatted console I/O functions - record I/O(fread(), fwrite(), ftell(), fseek(), rewind(), rename()), Record operations (append, delete, update, search, display, sorting of records) checking file opening error, closing data files; Command line parameters.

***Text Books*:**

1. Kanetkar, Y.: Let us C (B. P. B Publication), 1993 Edition.

References :

1. Gottfried, B. S.: Theory and Problems of Programming with C (Tata McGraw Hill Publication), 1998 Edition.
2. Balaguruswamy, E.: Programming in ANSI C (Tata McGraw Hill publication), 2002 Edition.
3. Rajaraman, V.: Computer Programming in C (Prentice Hall of India), 2002 Edition.

SIXTH SEMESTER

COMPUTER PROGRAMMING IN C (THEORY)

Coure/Paper No : MATH/6/CC/364CP

Marks : 100 *2*
Credits
(CA:40, End Sem:60) *(0-0-2)*

Practice the following programs.

1. Roots of quadratic equation $Ax^2+Bx+C=0$,
2. Arrangement a given set of numbers in increasing/decreasing order; calculation of mean,
3. Evaluation e^x, sin x, cos x, log(l+x) using power series method,
4. Solution of simple/algebraic/transcendental equations; Newton's method (real roots only),
5. Addition, subtraction and multiplication of matrices using function,
6. Evaluation of factorial of a positive integer and evaluation of binomial coefficients,
7. Determination of the transpose, determinant of the given matrix.(up to order 4),
8. Determination of the inverse of a given real matrix (up to order 4),
9. Searching a pattern in a given text and replacing every occurrence of it with another given string,
10. Writing a given number in words using function,
11. Copying the contents of one text to another text file using command line arguments,
12. Merging two text files to another text file,
13. Copying the contents of one text file to any number of given files using command line arguments,
14. Printing of every line of a text file containing a given pattern.

NOTE : There will be practical examination of three hours in which a candidate has to do two programs.