LESSON PLAN

PROGRAM NAME: B.Sc. (Honours)

COURSE: MATHEMATICS(Hons) 1st Semester

PAPER NAME: Calculus & Geometry **PAPER CODE: DC01**

NAME OF TEACHER(S): RAKESH SARKAR(R.S.), Dr. TILAK KUMAR PAUL(T.K.P.)

Unit-1

Real-valued functions defined on an interval, limit of a function (Cauchy's definition). Algebra of limits. Continuity of a function at a point and in an interval. Acquaintance with the important properties of continuous functions no closed intervals. Hyperbolic functions, higher order derivatives, Leibnitz rule of successive differentiation and its applications to problems of type $e^{ax}+b\sin x$, $e^{ax}+b\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$, concavity and inflection points, envelopes, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

Unit-2

Reduction formulae, derivations and illustrations of reduction formulae of the type integration of $\sin^n x$, $\cos^n x$, $\tan^n x$, $\sec^n x$, $(\log x)^n$, $\sin^n x \sin^m x$, evaluation of definite integrals, integration as the limit of a sum, concept of improper integration, use of Beta and Gamma functions. parametric equations, parametrizing a curve, arc length, arc length of parametric curves, area of surface of revolution. Techniques of sketching conics.

Unit-3

Reflection properties of conics, translation and rotation of axes and second degree equations, reduction and classification of conics using the discriminant, Point of intersection of two intersecting straight lines. Angle between two lines, Equation of bisectors. Equation of two lines joining the origin to the points in which a line meets a conic. Equations of pair of tangents from an external point, chord of contact, Polar equations of straight lines and conics. Equation of chord joining two points. Equations of tangent and normal.

Unit-4

Acquaintance of plane and straight line in 3D may be assumed. Spheres. Cylindrical surfaces. Central coincides, paraboloids, plane sections of coincides, Generating lines, reduction and classification of quadrics, Illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Class	Topic		TEACHER	
Lecture 1	Real-valued functions defined on an interval, limit of a function (Cauchy's definition).	Unit-1	TKP	September-6 Classes
Lecture 2	Algebra of limits. Continuity of a function at a point and in an interval.		TKP	
Lecture 3	Acquaintance with the important properties of continuous functions no closed intervals.		TKP	
Lecture 4	Hyperbolic functions, higher order derivatives		TKP	
Lecture 5	Leibnitz rule of successive differentiation		TKP	
Lecture 6	Applications of Leibnitz rule to problems of type $e^{ax}+b\sin x$, $e^{ax}+b\cos x$, $(ax+b)^n \sin x$, $(ax+b)^n \cos x$,		TKP	

Lecture 7	concavity and inflection points	Unit-1	TKP	November-5 Classes
Lecture 8	Envelopes, Asymptotes		TKP	
Lecture 9	Curve tracing in Cartesian coordinates		TKP	
Lecture 10	Curve tracing in polar coordinates of standard curves		TKP	
Lecture 11	L'Hospital's rule, applications in business, economics and life sciences.		TKP	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 11 and Assignment-1		TKP	
Lecture 12	Reduction formulae	Unit-2	TKP	December-6 Classes February-3 Classes, January-5 Classes
Lecture 13	derivations and illustrations of reduction formulae of the type integration of sinn x, cosn x, tann x,		TKP	
Lecture 14	derivations and illustrations of reduction formulae of the type integration of secn x, (log x)n, sinn x sinm x,		TKP	
Lecture 15	evaluation of definite integrals		TKP	
Lecture 16	, integration as the limit of a sum,		TKP	
Lecture 17	concept of improper integration		TKP	
Lecture 18	use of Beta and Gamma functions		TKP	
Lecture 19	parametric equations, parametrizing a curve		TKP	
Lecture 20	arc length, arc length of parametric curves		TKP	
Lecture 21	area of surface of revolution		TKP	
Lecture 22	Techniques of sketching conics		TKP	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 22 and Assignment-2		TKP	
Lecture 23	Reflection properties of conics	Unit-3	RS	November-5 Classes, September-4 Classes
Lecture 24	translation and rotation of axes		RS	
Lecture 25	second degree equations		RS	
Lecture 26	reduction and classification of conics using the discriminant-1		RS	
Lecture 27	reduction and classification of conics using the discriminant-2		RS	
Lecture 27	Angle between two lines		RS	
Lecture 28	Equation of bisectors		RS	
Lecture 29	Equation of two lines joining the origin to the points in which a line meets a conic.		RS	
Lecture 30	Equations of pair of tangents from an external point		RS	
Lecture 31	chord of contact		RS	
Lecture 32	Polar equations of straight lines and conics		RS	

Lecture 33	Equation of chord joining two points	Unit-3	RS	
Lecture 34	Equations of tangent and normal.		RS	
Examination	Class Test-3(Tutorial Exam) on Lecturer 23 to Lecturer 34 and Assignment-3		RS	
Lecture 35	Acquaintance of plane in 3D.	Unit-4	RS	February 2 Classes, January-5 Classes December- 4 Classes
Lecture 36	Acquaintance of straight line in 3D		RS	
Lecture 37	Spheres		RS	
Lecture 38	Cylindrical surfaces		RS	
Lecture 39	Central coincides		RS	
Lecture 40	paraboloids		RS	
Lecture 41	plane sections of coincides		RS	
Lecture 42	Generating lines		RS	
Lecture 43	reduction and classification of quadrics-1		RS	
Lecture 44	reduction and classification of quadrics-2		RS	
Lecture 45	Illustrations of graphing standard quadric surface-cone		RS	
Lecture 46	Illustrations of graphing standard quadric surface-ellipsoid		RS	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 46 and Assignment-4		RS	

Graphical Demonstration (Teaching Aid)

1. Plotting of graphs of function $e^{ax+b}, log(ax + b), sin(ax + b), cos(ax + b), |ax + b|$
and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).
4. Obtaining surface of revolution of curves.
5. Tracing of conics in Cartesian coordinates/polar coordinates.
6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, and hyperbolic paraboloid using Cartesian coordinates.

Text/Reference Books:

1. S.L. Loney, The Elements of Coordinate Geometry, Macmillan and Co., 1895.
2. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson, 2005.
3. M.J. Strauss, G.L. Bradley and K.J. Smith, Calculus, 3rd Ed., Pearson Education, 2007.
4. H. Anton, I. Bivens and S. Davis, Calculus, 10th Ed., John Wiley and Sons Inc., 2012.
5. R. Courant and F. John, Introduction to Calculus and Analysis (Volumes I & II), Springer, 1989.
6. T.M. Apostol, Calculus (Volumes I & II), John Wiley & Sons, 1967.
7. S. Goldberg, Calculus and mathematical analysis.
8. S. Lang, A First Course in Calculus, Springer 1998.
9. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2nd ed., 2013.
10. R.J.T. Bell, An Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan Publishers India Limited, 2000.

PROGRAM NAME: B.Sc. (Honours)

COURSE: MATHEMATICS(Hons) 1st Semester

PAPER NAME: Algebra **PAPER CODE: DC02**

NAME OF TEACHER(S): MD SAHID ALAM(S.A.), POLY KARMAKAR(P.K.)

Unit-1

Polar representation of complex numbers, n-th roots of unity, De Moivre's theorem for rational indices and its applications. Inequality: The inequality involving AM≥GM≥HM, mth power theorem, Cauchy-Schwartz inequality. Maximum and minimum values of a polynomials.

Unit-2

General properties of equations, Fundamental theorem of classical algebra(statement only) and its application, Transformation of equation, Descarte's rule of signs positive and negative rule, Strum's theorem, Relation between the roots and the coefficients of equations. Symmetric func- tions. Applications of symmetric function of the roots. Solutions of reciprocal and binomial equations. Algebraic solutions of the cubic (Cardon's) and biquadratic (Ferrari's). Properties of the derived functions.

Unit-3

Equivalence relations and partitions, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set. Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

Unit-4

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$, solution sets of linear systems, applications of linear systems, linear indepen- dence. Real Quadratic Form involving not more than three variables. Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors. Cayley-Hamilton Theorem.

Class	Topic		TEACHER	
Lecture 1	Polar representation of complex numbers.	Unit-1	SA	November-5 Classes, September-6 Classes
Lecture 2	De Moivre's theorem for rational indices and its applications.		SA	
Lecture 3	Inequality: The inequality involving AM≥GM≥HM		SA	
Lecture 4	mth power theorem,		SA	
Lecture 5	Cauchy-Schwartz inequality.		SA	
Lecture 6	Maximum and minimum values of a polynomials.		SA	
Lecture 7	General properties of equations		SA	
Lecture 8	Fundamental theorem of classical algebra(statement only) and its application.		SA	
Lecture 9	Transformation of equation		SA	
Lecture 10	Descarte's rule of signs positive and negative rule		SA	
Lecture 11	Strum's theorem,		SA	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 11 and Assignment-1		SA	
Lecture 12	Relation between the roots and the coefficients of equations.	Unit-2	SA	January-3 Classes December-3 Classes
Lecture 13	Symmetric functions. Applications of symmetric function of the roots.		SA	
Lecture 14	Solutions of reciprocal and binomial equations.		SA	
Lecture 15	Algebraic solutions of the cubic (Cardon's)		SA	
Lecture 16	Biquadratic (Ferrari's).		SA	
Lecture 17	Properties of the derived functions		SA	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 17 and Assignment-2		SA	
Lecture 18	Equivalence relations and partitions.	Unit-3	PK	November-5 Classes, September-4 Classes
Lecture 19	Functions, Composition of functions		PK	
Lecture 20	Invertible functions, One to one correspondence and cardinality of a set.		PK	
Lecture 21	Well-ordering property of positive integers,		PK	
Lecture 22	Division algorithm,		PK	
Lecture 23	Divisibility and Euclidean algorithm		PK	
Lecture 24	Congruence relation between integePK.		PK	
Lecture 25	Principles of Mathematical Induction,		PK	
Lecture 26	statement of Fundamental Theorem of Arithmetic		PK	

Examination	Class Test-3(Tutorial Exam) on Lecturer 18 to Lecturer 26 and Assignment-3		PK	
Lecture 27	Systems of linear equations,	Unit-4	PK	February 2 Classes, January-5 Classes December- 4 Classes
Lecture 27	Row reduction and echelon forms, vector equations,		PK	
Lecture 28	The matrix equation Ax = b, solution sets of linear systems.		PK	
Lecture 29	Applications of linear systems, linear independence.		PK	
Lecture 30	Real Quadratic Form involving not more than three variables		PK	
Lecture 31	Characteristic equation of square matrix of order not more than three determination of Eigen Values and Eigen Vectors.		PK	
Lecture 32	Eigen Values and Eigen Vectors.		PK	
Lecture 33	Cayley-Hamilton Theorem.		PK	
Lecture 34	Cayley-Hamilton Theorem.		PK	
Examination	Class Test-4(Tutorial Exam) on Lecturer 27 to Lecturer 34 and Assignment-4		PK	

Text/Reference Books:

1. T. Andreescu and D. Andrica, Complex Numbers from A to . . . Z, Birkhauser Boston, 2008.
2. D.C. Lay, S.R. Lay and J.J. McDonald, Linear Algebra and its Applications, 5rd Ed., Pearson, 2014.
3. K.B. Dutta, Matrix and linear algebra, Prentice Hall, 2004.
4. K. Hoffman and R. Kunze, Linear algebra, Prentice Hall, 1971.
5. W.S. Burnstine and A.W. Panton, Theory of equations, Nabu Press, 2011.
6. S.H. Friedberg, A.J. Insel and L.E. Spence, Linear Algebra, 4th Ed., PHI, 2004.
7. S. Bernard and J.M. Child, Higher Algebra, Macmillan and Co. 1952.

PROGRAM NAME: B.Sc. (Honours)

COURSE: MATHEMATICS(Hons) 2nd Semester

PAPER NAME: Real Analysis I **PAPER CODE: DC03**

NAME OF TEACHER(S): POLY KARMAKAR(P.K.), MD. SAHID ALAM(S.A.)

Unit-1

Development of real numbers. The algebraic properties of R, rational and irrational numbers, the order properties of R. Absolute value and the real line, bounded and unbounded sets in R, supremum and infimum, neighbourhood of a point. The completeness property of R, the Archimedean property, density of rational numbers in R, nested intervals property, binary representation of real numbers, uncountability of R. Closed set, open set, closure & interior of a subset of the real line.

Unit-2

Sequences, the limit of a sequence and the notion of convergence, bounded sequences, limit theorems, squeeze theorem, monotone sequences, monotone convergence theorem. Subsequences, monotone subsequence theorem and the Bolzano-Weierstrass theorem, the divergence criterion, limit superior and limit inferior of a sequence, Cauchy sequences, Cauchy's convergence criterion. Infinite series, convergence and divergence of infinite series. Tests for Convergence: Comparison test, root test, ratio test, integral test. Alternating series, absolute and conditional convergence.

Unit-3

Sequential criterion for limits, divergence criteria. Limit theorems, infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorems.

Unit-4

Differentiability of a function at a point and in an interval, Caratheodory's theorem, chain rule, derivative of inverse functions, algebra of differentiable functions. Mean value theorems, Rolle's Theorem, Lagrange's mean value theorem. Applications of mean value theorem to inequalities, relative extremum and approximation of polynomials. The intermediate value property of derivatives, Darboux's theorem. L'Hospital's rule. Taylor's theorem and its application. Expansion of functions.

Class	Topic		TEACHER	
Lecture 1	Development of real numbers. The algebraic properties of R, rational and irrational numbers, the order properties of R.	Unit-1	PK	March-5 Classes
Lecture 2	Absolute value and the real line, bounded and unbounded sets in R, supremum and infimum, neighbourhood of a point.		PK	
Lecture 3	The completeness property of R, the Archimedean property, density of rational numbers in R.		PK	
Lecture 4	Nested intervals property, binary rep- resentation of real numbers.		PK	
Lecture 5	Exercise solve		PK	
Lecture 6	Discussion		PK	
Lecture 7	Uncountability of R		PK	

Lecture 8	Closed set, open set.		PK	April-6 Classes
Lecture 9	Closure & interior of a subset of the real line.		PK	
Lecture 10	Exercise solve		PK	
Lecture 11	Discussion		PK	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 11 and Assignment-1		PK	
Lecture 12	Sequences, the limit of a sequence and the notion of convergence.	Unit-2	SA	June-5 Classes, May-6 Classes
Lecture 13	Bounded sequences, limit theorems, squeeze theorem, monotone sequences, monotone convergence theorem		SA	
Lecture 14	Subsequences, monotone subsequence theorem		SA	
Lecture 15	Tthe Bolzano-Weierstrass theorem, the divergence criterion		SA	
Lecture 16	Limit superior and limit inferior of a sequence		SA	
Lecture 17	Cauchy sequences, Cauchy's convergence criterion		SA	
Lecture 18	Infinite series, convergence and divergence of infinite series.		SA	
Lecture 19	Tests for Convergence: Comparison test		SA	
Lecture 20	Root test, ratio test, integral test.		SA	
Lecture 21	Alternating series, absolute and conditional convergence		SA	
Lecture 22	Exercise solve		SA	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 22 and Assignment-2		SA	
Lecture 23	Sequential criterion for limits	Unit-3	SA	April-6 Classes, March-5 Classes
Lecture 24	Divergence criteria		SA	
Lecture 25	Limit theorems, infinite limits and limits at infinity		SA	
Lecture 26	Continuous functions,		SA	
Lecture 27	Sequential criterion for continuity and discontinuity.		SA	
Lecture 27	Algebra of continuous functions.		SA	
Lecture 28	Continuous functions on an interval		SA	
Lecture 29	Intermediate value theorem, location of roots theorem,		SA	
Lecture 30	Preservation of intervals theorem.		SA	
Lecture 31	Uniform continuity		SA	
Lecture 32	Non-uniform continuity criteria		SA	
Lecture 33	Uniform continuity theorems.		SA	

Lecture 34	Exercise solve		SA	
Examination	Class Test-3(Tutorial Exam) on Lecturer 23 to Lecturer 34 and Assignment-3		SA	
Lecture 35	Differentiability of a function at a point and in an interval,	Unit-4	PK	June-6 Classes, May-6 Classes
Lecture 36	,Caratheodory's theorem, chain rule		PK	
Lecture 37	Derivative of inverse functions, algebra of differentiable functions.		PK	
Lecture 38	Mean value theorems		PK	
Lecture 39	Rolle's Theorem, Lagrange's mean value theorem.		PK	
Lecture 40	Applications of mean value theorem to inequalities		PK	
Lecture 41	Relative extremum and approximation of polynomials.		PK	
Lecture 42	The intermediate value property of derivatives		PK	
Lecture 43	Darboux's theorem. L'Hospital's rule.		PK	
Lecture 44	Taylor's theorem and its application.		PK	
Lecture 45	Expansion of functions.		PK	
Lecture 46	Exercise solve		PK	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 46 and Assignment-4		PK	

Graphical Demonstration (Teaching Aid)

1. Plotting of recursive sequences.
2. Study the convergence of sequences through plotting.
3. Verify Bolzano-Weierstrass theorem through plotting of sequences and hence identify convergent subsequences from the plot.
4. Study the convergence/divergence of infinite series by plotting their sequences of partial sum.
5. Cauchy's root test by plotting n-th roots, Ratio test by plotting the ratio of n-th and $(n+1)$-th term.

Text/Reference Books:

1. R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., Wiley, 2000.
2. G.G. Bilodeau , P.R. Thie and G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2009.
3. B.S. Thomson, A.M. Bruckner and J.B. Bruckner, Elementary Real Analysis,

Prentice Hall, 2001.
4. S.K. Berberian, A First Course in Real Analysis, Springer, 1998.
5. T.M. Apostol, Mathematical Analysis, Narosa, 2002.
6. R. Courant and F. John, Introduction to Calculus and Analysis, Vol I, Springer, 1999.
7. W. Rudin, Principles of Mathematical Analysis, McGraw Hill, 2017.
8. C.C. Pugh, Real Mathematical Analysis, Springer, 2002.
9. T. Tao, Analysis I, Hindustan Book Agency, 2006
10. S. Goldberg, Calculus and mathematical analysis.
11. H.R. Beyer, Calculus and Analysis, Wiley, 2010.
12. S. Lang, Undergraduate Analysis, Springer, 2nd Ed., 1997.
13. A. Kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.

PROGRAM NAME: B.Sc. (Honours)
COURSE: MATHEMATICS(Hons) 2nd Semester
PAPER NAME: Abstract Algebra **PAPER CODE: DC04**
NAME OF TEACHER(S): RAKESH SARKAR (R.S.), Dr. TILAK KUMAR PAL (T.K.P.)

Unit-1

Definition and examples of groups, elementary properties of groups. Subgroups and examples of subgroups, centralizer, normalizer, center of a group. Properties of cyclic groups, classification of subgroups of cyclic groups. Permutation group, cycle notation for permutations, properties of permutations, even and odd permutations, alternating group. Cosets, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem. Normal subgroup and quotient group.

Unit-2

Group homomorphisms, properties of homomorphisms, properties of isomorphisms. First, Second, and Third isomorphism theorems. External direct product of a finite number of groups, Cauchy's theorem for finite abelian groups. Cayley's theorem.

Unit-3

Definition and examples of rings, elementary properties of rings, subrings, integral domains and fields, characteristic of a ring. Ring homomorphisms, properties of ring homomorphisms. First Isomorphism theorem. Isomorphism theorems II and III (statement only), field of quotients. Elementary properties of field, Introduction to polynomial ring.

Unit-4

Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Class	Topic		TEACHER	
Lecture 1	Definition and examples of groups.	Unit-1	TKP	April-6 Classes, March-5 Classes
Lecture 2	Elementary properties of groups.		TKP	
Lecture 3	Subgroups and examples of subgroups.		TKP	
Lecture 4	centralizer, normalizer, center of a group.		TKP	
Lecture 5	Properties of cyclic groups,		TKP	
Lecture 6	classification of subgroups of cyclic groups		TKP	
Lecture 7	Permutation group, cycle notation for permutations,		TKP	
Lecture 8	properties of permutations, even and odd permutations,		TKP	
Lecture 9	alternating group , examples		TKP	
Lecture 10	Cosets, properties of cosets,		TKP	
Lecture 11	Lagrange's theorem and consequences including Fermat's Little theorem.		TKP	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 11 and Assignment-1		TKP	
Lecture 12	Normal subgroup and quotient group.	Unit-2	TKP	June-5 Classes, May-6 Classes
Lecture 13	Group homomorphisms, properties of homomorphisms,		TKP	
Lecture 14	properties of isomorphisms.		TKP	
Lecture 15	First isomorphism theorems.		TKP	
Lecture 16	Second isomorphism theorems.		TKP	
Lecture 17	Third isomorphism theorems.		TKP	
Lecture 18	External direct product of a finite number of groups,		TKP	
Lecture 19	Cauchy's theorem for finite abelian groups.		TKP	
Lecture 20	Cayley's theorem and its application		TKP	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 20 and Assignment-2		TKP	
Lecture 21	Definition and examples of rings,	Unit-3	RS	March-5 Classes
Lecture 22	elementary properties of rings,		RS	
Lecture 23	Subrings, some properties and		RS	
Lecture 24	Integral domains and properties.		RS	
Lecture 25	characteristic of a ring		RS	
Lecture 26	Fields and their properties		RS	
Lecture 27	Ring homomorphisms, properties of ring homomorphisms.		RS	

Lecture 27	First Isomorphism theorem.	Unit-3	RS	April-6 Classes,
Lecture 29	Isomorphism theorems II and III (statement only),		RS	
Lecture 30	field of quotients. Elementary properties of field,		RS	
Lecture 31	Introduction to polynomial ring.		RS	
Examination	Class Test-3(Tutorial Exam) on Lecturer 21 to Lecturer 31 and Assignment-3		RS	
Lecture 32	Definition of Ideal, example	Unit-4	RS	June-5 Classes, May-6 Classes
Lecture 33	ideal generated by a subset of a ring,		RS	
Lecture 34	factor rings, and its example		RS	
Lecture 35	operations on ideals,		RS	
Lecture 36	Prime and its properties		RS	
Lecture 37	Definition of maximal ideals and some theorem		RS	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 37 and Assignment-4		RS	

Text/Reference Books:

1. J.B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. J.A. Gallian, Contemporary Abstract Algebra, 8th Ed., Houghton Mi_in, 2012.
4. J.J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer, 1995.
5. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, 1975.
6. D.S. Malik, J.M. Mordeson and M.K. Sen, Fundamentals of Abstract Algebra, McGraw,Hill, 1996.
7. D.S. Dummit and R.M. Foote, Fundamentals of Abstract Algebra, 3rd Ed., Wiley, 2003.
8. M.K. Sen, S. Ghosh, P. Mukhopadhyay and S.K. Maiti, Topics in Abstract Algebra, 3rd ed. University press, 2019.

PROGRAM NAME: B.Sc. (Honours)
COURSE: MATHEMATICS(Hons) 3rd Semester
PAPER NAME: Real Analysis II **PAPER CODE: DC05**
NAME OF TEACHER(S): MD SAHID ALAM(S.A), POLY KAMAKAR(P.K.)

Unit-1

Properties of monotone functions. Functions of bounded variation, total variation, continuous functions of bounded variation. Curves and paths, rectifiable paths and arc length.

Unit-2

Riemann integration: upper and lower sums, upper and lower integral, definition and conditions of integrability. Riemann integrability of monotone and continuous functions, elementary properties of the Riemann integral. Intermediate Value theorems for Integrals. Fundamental theorem of Integral Calculus, change of variables.

Unit-3

Periodic function, Fourier coefficient & Fourier series, convergence, Bessel's inequality, Parseval's inequality, Dirichlet's condition, example of Fourier series. Improper integrals: Range of integration, finite or infinite. Necessary and sufficient condition for convergence of improper integral. Tests of convergence: Comparison and M-test. Absolute and non-absolute convergence and inter-relations. Statement of Abel's and Dirichlet's test for convergence on the integral of a product. Convergence and working knowledge of Beta and Gamma function and their inter-relation.

Unit-4

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, differentiability and integrability of the limit function of a sequence of functions. Series of functions; Theorems on the continuity and differentiability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Class	Topic		TEACHER	
Lecture 1	Properties of monotone functions.	Unit-1	SA	July-6 Classes
Lecture 2	Functions of bounded variation with examples		SA	
Lecture 3	Total variation, Calculate total variation		SA	
Lecture 4	Continuous functions of bounded variation		SA	
Lecture 5	Curves and paths,		SA	
Lecture 6	rectifiable paths and arc length		SA	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 6 and Assignment-1		SA	

Lecture 7	Riemann integration	Unit-2	PK	August-9 Classes
Lecture 8	Upper and lower sums,		PK	
Lecture 9	Upper and lower integral,		PK	
Lecture 10	Definition and conditions of integrability.		PK	
Lecture 11	Riemann integrability of monotone and continuous functions,		PK	
Lecture 12	Elementary properties of the Riemann integral.		PK	
Lecture 13	Intermediate Value theorems for Integrals.		PK	
Lecture 14	Fundamental theorem of Integral Calculus,		PK	
Lecture 15	Change of variables.		PK	
Examination	Class Test-2(Tutorial Exam) on Lecturer 7 to Lecturer 15 and Assignment-2		PK	
Lecture 16	Periodic function examples	Unit-3	SA	November-5 Classes, September -6 Classes
Lecture 17	Fourier coefficient & Fourier series		SA	
Lecture 18	convergence, Bessel's inequality		SA	
Lecture 19	Parseval's inequality, Dirichlet's condition,		SA	
Lecture 20	example of Fourier series.		SA	
Lecture 21	Necessary and sufficient condition for convergence of improper integral.		SA	
Lecture 22	Tests of convergence: Comparison and M-test.		SA	
Lecture 23	Absolute and non-absolute convergence and inter-relations.		SA	
Lecture 24	Statement of Abel's and Dirichlet's test for convergence on the integral of a product.		SA	
Lecture 25	Convergence and working knowledge of Beta		SA	
Lecture 26	Convergence and working knowledge Gamma function and their inter-relation.		SA	
Examination	Class Test-3(Tutorial Exam) on Lecturer 16 to Lecturer 26 and Assignment-3		SA	
Lecture 27	Pointwise and uniform convergence of sequence of functions.	Unit-4	PK	November -3 Classes
Lecture 28	Theorems on continuity,		PK	
Lecture 29	differentiability and the limit function of a sequence of functions		PK	

Lecture 30	Integrability of the limit function of a sequence of functions		PK	December-6 Classes
Lecture 31	Series of functions;		PK	
Lecture 32	Theorem of Continuity of the sum function of a series of functions;		PK	
Lecture 33	differentiability of the sum function of a series of functions;		PK	
Lecture 34	Cauchy criterion for uniform convergence		PK	
Lecture 35	Weierstrass M-Test.		PK	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 35 and Assignment-4		PK	

Reference Books

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
2. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
3. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
4. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
5. T.M. Apostol, Mathematical Analysis, Narosa Publishing House
6. R. Courant and F. John, Introduction to Calculus and Analysis, Vol II, Springer
7. W. Rudin, Principles of Mathematical Analysis, McGraw Hill, 2017.
8. T. Tao, Analysis II, Hindustan Book Agency, 2006
9. S. Shirali and H.L. Vasudeva, Metric Spaces, Springer, 2006.
10. G.G. Bilodeau , P.R. Thie and G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
11. B.S. Thomson, A.M. Bruckner and J.B. Bruckner, Elementary Real Analysis,Prentice Hall, 2001.
12. C.C. Pugh, Real Mathematical Analysis, Springer, 2002.
13. H.R. Beyer, Calculus and Analysis, Wiley, 2010.
14. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
15. S. Goldberg, Calculus and Mathematical Analysis.
16. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004.

17. 17. S. Lang, Undergraduate Analysis, 2nd Ed., Springer, 1997.

PROGRAM NAME: B.Sc. (Honours)
COURSE: MATHEMATICS(Hons) 3rd Semester
PAPER NAME: **Linear Algebra** **PAPER CODE: DC06**
NAME OF TEACHER(S): POLY KAMAKAR(P.K.)

Unit-1

Definition and examples of vector spaces, subspaces, linear combination of vectors, linear span, linear dependence and independence, bases and dimension.

Unit-2

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Unit-3

Linear operator and its eigen value and eigen vectors, characteristic equation, eigenspace, algebraic and geometric multiplicity of eigenvalues. Diagonalization, conditions for diagonalizability. Invariant subspace and Cayley-Hamilton theorem, simple application of Caley-Hamilton Theorem.

Unit-4

Inner products and norms, special emphasis on Euclidean spaces. Orthogonal and orthonormal vectors, Gram-Schmidt orthogonalisation process, orthogonal complements. The adjoint of a linear operator, unitary, orthogonal and normal operators.

Class	Topic		TEACHER	
Lecture 1	Definition and examples of vector spaces	Unit-1	PK	July-7 Classes
Lecture 2	Subspaces		PK	
Lecture 3	Linear combination of vectors		PK	
Lecture 4	Llinear span,		PK	
Lecture 5	Linear dependence and independence		PK	
Lecture 6	Bases		PK	
Lecture 7	Dimension		PK	

Lecture 8	Linear transformations	Unit-1	PK	August-5 Classes
Lecture 9	Null space, range		PK	
Lecture 10	Rank of a linear transformation		PK	
Lecture 11	Nullity of a linear transformation		PK	
Lecture 12	Discussion		PK	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 12 and Assignment-21		PK	
Lecture 13	Matrix representation of a linear transformation	Unit-2	PK	September -6 Classes, August-5 Classes
Lecture 14	Application of matrix representation of a linear transformation		PK	
Lecture 15	Algebra of linear transformations		PK	
Lecture 16	Isomorphisms		PK	
Lecture 17	Isomorphism theorems,		PK	
Lecture 18	Invertibility		PK	
Lecture 19	Isomorphisms		PK	
Lecture 20	Change of coordinate matrix		PK	
Lecture 21	Application of change of coordinate matrix		PK	
Lecture 22	Discussion		PK	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 22 and Assignment-2		PK	
Lecture 23	Linear operator	Unit-3	PK	November-9 Classes, October -3 Classes
Lecture 24	Linear operator's eigen value		PK	
Lecture 25	Linear operator's eigen vectors		PK	
Lecture 26	Characteristic equation		PK	
Lecture 27	Eigenspace		PK	
Lecture 27	Algebraic multiplicity of eigenvalues		PK	
Lecture 28	Geometric multiplicity of eigenvalues		PK	
Lecture 29	Diagonalization		PK	
Lecture 30	Conditions for diagonalizability		PK	
Lecture 31	Application of diagonalizability		PK	
Lecture 32	Cayley-Hamilton theorem		PK	

Lecture 33	Application of Caley-Hamilton Theorem.		PK	
Lecture 34	Discussion		PK	
Examination	Class Test-3(Tutorial Exam) on Lecturer 23 to Lecturer 34 and Assignment-3		PK	
Lecture 35	Inner products	Unit-4	PK	January -2 Classes, December -9 Classes
Lecture 36	Norms		PK	
Lecture 37	Special emphasis on Euclidean spaces		PK	
Lecture 38	Orthogonal vectors		PK	
Lecture 39	Orthonormal vectors		PK	
Lecture 40	Gram-Schmidt orthogonalisation process		PK	
Lecture 41	Orthogonal complements		PK	
Lecture 42	The adjoint of a linear operator		PK	
Lecture 43	Unitary , Orthogonal operators		PK	
Lecture 44	Normal operators.		PK	
Lecture 45	Discussion		PK	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 45 and Assignment-4		PK	

Reference Books

1. S.H. Friedberg, A.J. Insel and L.E. Spence, Linear Algebra, 4th Ed., PHI, 2004.
2. J.B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
3. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
4. A.R. Rao and P. Bhimasankaram, Linear Algebra, Hindustan Book Agency, 2000.
5. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
6. G. Strang, Linear Algebra and its Applications, Thomson, 2007.
7. S. Kumaresan, Linear Algebra- A Geometric Approach, PHI, 1999.
8. K. Hoffman and R.A. Kunze, Linear Algebra, 2nd Ed., PHI, 1971.
9. S. Axler, Linear Algebra Done Right, Springer, 2014.
10. S.J. Leon, Linear Algebra with Applications, Pearson, 2015.
11. J.S. Golan, Foundations of Linear Algebra, Springer, 1995.

PROGRAM NAME: B.Sc. (Honours)
COURSE: MATHEMATICS(Hons) 3rd Semester
PAPER NAME: Multivariate Calculus & Vector Calculus **PAPER CODE: DC07**
NAME OF TEACHER(S): RAKESH SARKAR(R.S.), POLY KAMAKAR(P.K.)

Unit-1

Functions of several variables, limit and continuity of functions of two or more variables, directional derivative and partial differentiation, Schwartz's & Young's theorem and Euler's theorem for homogenous function, total differentiability and Jacobian, sufficient condition for differentiability, Mean value theorem, Taylor's theorem, Implicit function theorem (statement only), the gradient, tangent planes. Chain rule for one and two independent parameters. Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems.

Unit-2

Double integration over rectangular region, double integration over non-rectangular region, changing the order of integration. Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates. Change of variables in double integrals and triple integrals.

Unit-3

Triple product, introduction to vector fields, operations with vector-valued functions, limits and continuity of vector functions, differentiation of vector valued function, gradient, divergence and curl. Curves and their parameterization, line integration of vector functions, circulation. Surface and volume integration.

Unit-4

Gauss's theorem, Green's theorem, Stoke's theorem and their simple applications.

Class	Topic		TEACHER	
Lecture 1	Functions of several variables	Unit-1	RS	August-6 Classes, July-6 Classes
Lecture 2	limit of functions of two or more variables		RS	
Lecture 3	continuity of functions of two or more variables		RS	
Lecture 4	directional derivative and partial differentiation,		RS	
Lecture 5	Schwartz's theorem for homogenous function of two variables		RS	
Lecture 6	Young's theorem and Euler's theorem for homogenous function of two variables		RS	
Lecture 7	Application of Schwartz's & Young's theorem and Euler's theorem for function of several variables		RS	
Lecture 8	total differentiability and Jacobian		RS	
Lecture 9	sufficient condition for differentiability, Mean value theorem		RS	
Lecture 10	Taylor's theorem, Implicit function theorem(statement only),), the gradient, tangent planes		RS	

Lecture 11	Chain rule for one and two independent parameters.		RS	
Lecture 12	Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems		RS	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 12 and Assignment-1		RS	
Lecture 13	Double integration over rectangular region	Unit-2	PK	September -6 Classes, August-5 Classes
Lecture 14	double integration over non-rectangular region		PK	
Lecture 15	changing the order of integration.		PK	
Lecture 16	Triple integrals		PK	
Lecture 17	Triple integral over a parallelepiped and solid regions-1		PK	
Lecture 18	Triple integral over a parallelepiped and solid regions-2		PK	
Lecture 19	Volume by triple integrals-1		PK	
Lecture 20	Volume by triple integrals-2		PK	
Lecture 21	cylindrical and spherical co-ordinates		PK	
Lecture 22	Change of variables in double integrals and triple integrals		PK	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 22 and Assignment-2		PK	
Lecture 23	Scalar and Vector triple product	Unit-3	RS	November-10 Classes, October -2 Classes
Lecture 24	introduction to vector fields		RS	
Lecture 25	operations with vector-valued functions		RS	
Lecture 26	limits and continuity of vector functions		RS	
Lecture 27	differentiation of vector valued function		RS	
Lecture 27	Gradient of scalar function, divergence of a vector field		RS	
Lecture 28	Curl of a vector field		RS	
Lecture 29	Curves and their parameterization		RS	
Lecture 30	line integration of vector functions		RS	
Lecture 31	circulation on a vector field		RS	
Lecture 32	Surface integration		RS	
Lecture 33	volume integration		RS	
Lecture 34	Miscellaneous examples on line, surface and volume integration		RS	
Examination	Class Test-3(Tutorial Exam) on Lecturer 23 to Lecturer 34 and Assignment-3		RS	

Lecture 35	Gauss's theorem		RS	
Lecture 36	Application of Gauss's theorem		RS	
Lecture 37	Application of Gauss's theorem	Unit-4	RS	January -3 Classes, December -8 Classes
Lecture 38	Green's theorem		RS	
Lecture 39	Application of Green's theorem		RS	
Lecture 40	Application of Green's theorem		RS	
Lecture 41	Stoke's theorem		RS	
Lecture 42	Application of Stoke's theorem	Unit-4	RS	
Lecture 43	Application of Stoke's theorem		RS	
Lecture 44	Miscellaneous examples on Gauss's theorem, Green's theorem, Stoke's theorem-1		RS	
Lecture 45	Miscellaneous examples on Gauss's theorem, Green's theorem, Stoke's theorem-2		RS	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 45 and Assignment-4		RS	

Reference Books

18. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson, 2005.
19. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Pearson, 2007.
20. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer, 2005.
21. J. Stewart, Multivariable Calculus, Concepts and Contexts, 4nd Ed., Cengage Learning, 2009.
22. T.M. Apostol, Mathematical Analysis, Narosa, 2002.
23. S.R. Ghorpade and B.V. Limaye, A Course in Multivariable Calculus and Analysis, Springer, 2010.
24. R. Courant and F. John, Introduction to Calculus and Analysis (Vol. II), Springer, 1999.
25. W. Rudin, Principles of Mathematical Analysis, McGraw Hill, 2017.
26. J.E. Marsden, and A. Tromba, Vector Calculus, W.H. Freeman, 1996.
27. T. Tao, Analysis II, Hindustan Book Agency, 2006
28. M.R. Speigel, Schaum's outline: Vector Analysis, McGraw Hill, 2017.
29. C.E. Weatherburn, Elementary Vector Analysis: With Application to Geometry and Physics, CBS Ltd., 1926.

PROGRAM NAME: B.Sc. (Honours)
COURSE: MATHEMATICS(Hons) 4th Semester

PAPER NAME: Differential Equations PAPER CODE: DC08

NAME OF TEACHER(S): POLY KARMAKAR(P.K.), Dr. TILAK KUMAR PAUL(T.K.P.)

Unit-1

Exact, linear and Bernoulli's equations. Equations not of first degree, Clairaut's equations, singular solution. Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian and its properties. Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters, Eigenvalue problem.

Unit-2

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions. Equilibrium points, Interpretation of the phase plane.

Unit-3

Power series solution of a differential equation about an ordinary point, solution about a regular singular point. Legendre polynomials, Bessel functions of the first kind and their properties.

Unit-4

Partial differential equations, basic concepts and definitions. First-Order Equations: classification, construction and geometrical interpretation. Method of characteristics for obtaining general solution of quasi linear equations. Canonical forms of first-order linear equations. Solution by Lagrange's and Charpit's method.

Class	Topic		TEACHER	
Lecture 1	Exact equations	Unit-1	PK	July-7 Classes
Lecture 2	Linear and Bernoulli's equations.		PK	
Lecture 3	Equations solving not of first degree		PK	
Lecture 4	Clairaut's equations		PK	
Lecture 5	Singular solution		PK	
Lecture 6	Lipschitz condition		PK	
Lecture 7	Picard's Theorem		PK	

Lecture 8	General solution of homogeneous equation of second order	Unit-1	PK	August-4 Classes
Lecture 9	Principle of super position for homogeneous equation		PK	
Lecture 10	Wronskian and its properties.		PK	
Lecture 11	Linear homogeneous equations of higher order with constant coefficients		PK	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 11 and Assignment-1		PK	
Lecture 12	Linear non-homogeneous equations of higher order with constant coefficients	Unit-2	PK	September-4 Classes, August-9 Classes
Lecture 13	Euler's equation		PK	
Lecture 14	Method of undetermined coefficients		PK	
Lecture 15	Method of variation of parameters		PK	
Lecture 16	Eigenvalue problem		PK	
Lecture 17	Systems of linear differential equations, types of linear systems		PK	
Lecture 18	Differential operators, an operator method for linear systems with constant coefficients		PK	
Lecture 19	Basic Theory of linear systems in normal form		RS	
Lecture 20	Homogeneous linear systems with constant coefficients		PK	
Lecture 21	Two Equations in two unknown functions		PK	
Lecture 22	Equilibrium points,		PK	
Lecture 23	Interpretation of the phase plane		PK	
Lecture 24	Discussion		PK	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 24 and Assignment-2		PK	
Lecture 25	Power series solution of a differential equation	Unit-3	TKP	September-8 Classes
Lecture 26	Problem solve		TKP	
Lecture 27	Power series solution of a differential equation about an ordinary point		TKP	
Lecture 27	Problem solve		TKP	
Lecture 28	Power series solution of a differential equation about a regular singular point		TKP	
Lecture 29	Problem solve		TKP	
Lecture 30	Legendre polynomials		TKP	
Lecture 31	Problem solve		TKP	

Lecture 32	Bessel functions of the first kind	Unit-3	TKP	November-4 Classes
Lecture 33	properties of Bessel functions of the first kind		TKP	
Lecture 34	Problem solve		TKP	
Lecture 35	Discussion		TKP	
Examination	Class Test-3(Tutorial Exam) on Lecturer 25 to Lecturer 35 and Assignment-3		TKP	
Lecture 36	Partial differential equations	Unit-4	TKP	December-8 Classes, November-3 Classes
Lecture 37	Basic concepts about partial differential equations		TKP	
Lecture 38	Problem solve		TKP	
Lecture 39	First- Order partial differential equations		TKP	
Lecture 40	First- Order Equations: classification		TKP	
Lecture 41	First- Order Equations: construction.		TKP	
Lecture 42	First- Order Equations: geometrical interpretation.		TKP	
Lecture 43	Method of characteristics for obtaining general solution of quasi linear equations		TKP	
Lecture 44	Canonical forms of first-order linear equations		TKP	
Lecture 45	Solution by Lagrange's method.		TKP	
Lecture 46	Solution by Charpit's method.		TKP	
Lecture 47	Discussion		TKP	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 47 and Assignment-4		TKP	

Graphical Demonstration (Teaching Aid)

1. Plotting of family of curves which are solutions of second order differential equation.
2. Plotting of family of curves which are solutions of third order differential equation.

Reference Books

1. G.F. Simmons, Differential Equations with Applications and Historical Notes, McGraw Hill, 2017.
2. S.L. Ross, Differential Equations, 3rd Ed., Wiley, 2007.
3. C.H. Edwards and D.E. Penny, Differential Equations and Boundary Value Problems Computing and Modeling, Pearson, 2005.
4. M.L. Abel and J.P. Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier, 2004.

5. D. Murray, Introductory Course in Differential Equations, Orient Longman, 2003.
6. W.E. Boyce and R.C. Diprima, Elementary Differential Equations and Boundary Value Problems, Wiley, 2009.
7. E.A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publications Inc., 1989.

PROGRAM NAME: B.Sc. (Honours)

COURSE: MATHEMATICS(Hons) 4th Semester

PAPER NAME: Mechanics **PAPER CODE: DC 09**

NAME OF TEACHER(S): MD SAHID ALAM (S.A.)

Mechanics

Unit-1

Coplanar forces in general: Resultant force and resultant couple, Special cases, Varignon's the- orem, Necessary and sufficient conditions of equilibrium. Equilibrium equations of the first, second and third kind.

An arbitrary force system in space: Moment of a force about an axis, Varignon's theorem. Resultant force and resultant couple, necessary and sufficient conditions of equilibrium. Equi- librium equations, Reduction to a wrench, Poinsot's central axis, intensity and pitch of a wrench, Invariants of a system of forces. Statically determinate and indeterminate problems.

Equilibrium in the presence of sliding Friction force: Contact force between bodies, Coulomb's laws of static Friction and dynamic friction. The angle and cone of friction, the equilibrium region.

Unit-2

Virtual work: Workless constraints- examples, virtual displacements and virtual work. The principle of virtual work, Deductions of the necessary and sufficient conditions of equilibrium of an arbitrary force system in plane and space, acting on a rigid body.

Stability of equilibrium: Conservative force field, energy test of stability, condition of stability of a perfectly rough heavy body lying on a fixed body. Rocking stones.

Unit-3

Kinematics of a particle: Velocity, acceleration, angular velocity, linear and angular momen- tum. Relative velocity and acceleration. Expressions for velocity and acceleration in case of rectilinear motion and planar motion in Cartesian and polar coordinates, tangential and normal components. Uniform circular motion.

Newton laws of motion and law of gravitation: Space, time, mass, force, inertial reference frame, principle of equivalence and g. Vector equation of motion. Work, power, kinetic energy, conservative forces-potential energy. Existence of potential energy function.

Energy conservation in a conservative field. Stable equilibrium and small oscillations: Ap- proximate equation of motion for small oscillation. Impulsive forces

Unit-4

Problems in particle dynamics: Rectilinear motion in a given force field - vertical motion under uniform gravity, inverse square field, constrained rectilinear motion, vertical motion under grav- ity in a resisting medium, simple harmonic motion, Damped and forced oscillations, resonance of an oscillating system, motion of elastic strings and springs.

Planar motion of a particle: Motion of a projectile in a resisting medium under gravity, or- bits in a central force field, Stability of nearly circular orbits. Motion under the attractive inverse square law, Kepler's laws on planetary motion. Slightly disturbed orbits, motion of artificial satellites. Constrained motion of a particle on smooth and rough curves. Equations of motion referred to a set of rotating axes.

Class	Topic		TEACHER	
Lecture 1	Coplanar forces in general: Resultant force and resultant couple, Special cases.	Unit-1	RS	August-3 Classes, July-9 Classes
Lecture 2	Coplanar forces,Varignon's theorem.		SA	
Lecture 3	Necessary and sufficient conditions of equilibrium.		SA	
Lecture 4	Equilibrium equations of the fiSAt, second and third kind.		SA	
Lecture 5	An arbitrary force system in space: Moment of a force about an axis,.		SA	
Lecture 6	Varignon's theorem.		SA	
Lecture 7	Resultant force and resultant couple, necessary and sufficient conditions of equilibrium.		SA	
Lecture 8	Equilibrium equations.		SA	
Lecture 9	Reduction to a wrench, Poinsot's central axis, intensity and pitch of a wrench.		SA	
Lecture 10	Invariants of a system of forces.		SA	
Lecture 11	Statically determinate and indeterminate problems.		SA	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 11 and Assignment-1		SA	
Lecture 12	Equilibrium in the presence of sliding Friction force.	Unit-2	SA	September-3 Classes, August-8 Classes
Lecture 13	Friction force: Contact force between bodies.		SA	
Lecture 14	Coulomb's laws of static Friction and dynamic friction.		SA	
Lecture 15	The angle and cone of friction, the equilibrium region.		SA	
Lecture 16	Virtual work: Workless constraints examples, virtual displacements and virtual work.		SA	
Lecture 17	The principle of virtual work.		SA	
Lecture 18	Deductions of the necessary and sufficient conditions of equilibrium of an arbitrary force system in plane and space, acting on a rigid body.		SA	
Lecture 19	Virtual work problems.		SA	
Lecture 20	Virtual work problems.		SA	
Lecture 21	Stability of equilibrium: Conservative force field.		SA	

Lecture 22	Energy test of stability.		SA	
Lecture 23	Condition of stability of a perfectly rough heavy body lying on a fixed body		SA	
Lecture 24	Rocking stones.		SA	
Examination	Class Test-2(Tutorial Exam) on Lecturer 12 to Lecturer 24 and Assignment-2		SA	
Lecture 25	Kinematics of a particle: Velocity, acceleration, angular velocity, linear and angular momentum.	Unit-3	SA	November-4 Classes, September-7 Classes
Lecture 26	Relative velocity and acceleration.		SA	
Lecture 27	Expressions for velocity and acceleration in case of rectilinear motion and planar motion in Cartesian and polar coordinates,.		SA	
Lecture 27	Expressions for velocity and acceleration in case of rectilinear motion and planar motion in tangential and normal components.		SA	
Lecture 28	Uniform circular motion.		SA	
Lecture 29	Newton laws of motion and law of gravitation: Space, time, mass, force, inertial reference frame, principle of equivalence and g.		SA	
Lecture 30	Vector equation of motion. Work, power		SA	
Lecture 31	Kinetic energy.		SA	
Lecture 32	Conservative forces-potential energy.		SA	
Lecture 33	Existence of potential energy function.		SA	
Lecture 34	Energy conservation in a conservative field.		SA	
Lecture 35	Energy conservation in a conservative field.		SA	
Examination	Class Test-3(Tutorial Exam) on Lecturer 25 to 35 and Assignment-3		SA	
Lecture 36	Stable equilibrium and small oscillations: Approximate equation of motion for small oscillation.	Unit-4	SA	November-9 Classes
Lecture 37	Impulsive forces		SA	
Lecture 38	Problems in particle dynamics: Rectilinear motion in a given force field - vertical motion under uniform gravity.		SA	
Lecture 39	Inverse square field, constrained rectilinear motion.		SA	
Lecture 40	vertical motion under gravity in a resisting medium,		SA	
Lecture 41	simple harmonic motion.		SA	
Lecture 42	Damped and forced oscillations		SA	
Lecture 43	Resonance of an oscillating system, motion of elastic strings and springs.		SA	
Lecture 44	Planar motion of a particle: Motion of a projectile in a resisting medium under gravity,		SA	

Lecture 45	orbits in a central force field	Unit-4	SA	December-6 Classes
Lecture 46	Stability of nearly circular orbits.		SA	
Lecture 47	Motion under the attractive inverse square law, Kepler's laws on planetary motion..		SA	
Lecture 48	Slightly disturbed orbits, motion of artificial satellites.		SA	
Lecture 49	Constrained motion of a particle on smooth and rough curves.		SA	
Lecture 50	Equations of motion referred to a set of rotating axes		SA	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 50 and Assignment-4		SA	

Reference Books

1. R.D. Gregory, Classical mechanics, Cambridge University Press, 2006.
2. K.R. Symon, Mechanics, Addison Wesley, 1971.
3. M. Lunn, A First Course in Mechanics, Oxford University Press, 1991.
4. J.L. Synge and B.A. Griffith, Principles of Mechanics, Mcgraw Hill, 1949.
5. T.W.B. Kibble, F.H. Berkshire, Classical Mechanics, Imperial College Press, 2004.
6. D.T. Greenwood, Principle of Dynamics, Prentice Hall, 1987.
7. F. Chorlton, Textbook of Dynamics, E. Horwood, 1983.
8. D. Kleppner and R. Kolenkow, Introduction to Mechanics, Mcgraw Hill, 2017.
9. A.P. French, Newtonian Mechanics, Viva Books, 2011.
10. S.P. Timoshenko and D.H. Young, Engineering Mechanics, Schaum Outline Series, 4th Ed., 1964.
11. D. Chernilevski, E. Lavrova and V. Romanov, Mechanics for Engineers, MIR Publishers
12. I.H. Shames and G.K.M. Rao, Engineering Mechanics: Statics and Dynamics, 4th Ed., Pearson, 2009.
13. R.C. Hibbeler and A. Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Pearson, Delhi.
14. S.L. Loney, An Elementary Treatise on the Dynamics of Particle and of Rigid Bodies, Loney Press, 2007.
15. S.L. Loney, An Elementary Treatise on Statics, Cambridge University Press, 2016.
16. R.S. Verma, A Textbook on Statics, Pothishala, 1962.
17. A.S. Ramsey, Dynamics (Part I & II), Cambridge University Press, 1952.

PROGRAM NAME: B.Sc. (Honours)

COURSE: MATHEMATICS(Hons) 4th Semester

PAPER NAME: Probability & Statistics **PAPER CODE: DC10**

NAME OF TEACHER(S): RAKESH SARKAR(R.S.)

Unit-1

Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Unit-2

Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Unit-3

Chebyshevs inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers. Central Limit theorem for independent and identically distributed random variables with finite variance.

Unit-4

Random Samples, Sampling Distributions. Estimation: Unbiasedness, consistency, the method of moments and the method of maximum likelihood estimation, confidence intervals for parameters in one sample problems of normal populations, confidence intervals for proportions, problems. Testing of hypothesis: Null and alternative hypotheses, the critical and acceptance regions, two types of error, Neyman-Pearson Fundamental Lemma, tests for one sample problems for normal populations, tests for proportions, Chi-square goodness of fit test and its applications.

Class	Topic		TEACHER	
Lecture 1	Sample space	Unit-1	RS	July-7 Classes
Lecture 2	probability axioms		RS	
Lecture 3	real random variables (discrete and continuous)		RS	
Lecture 4	cumulative distribution function		RS	
Lecture 5	probability mass/density functions		RS	
Lecture 6	mathematical expectation		RS	
Lecture 7	moments		RS	

Lecture 8	moment generating function	Unit-1	RS	August-5 Classes
Lecture 9	characteristic function		RS	
Lecture 10	Discrete distributions & continuous distributions		RS	
Lecture 11	Discrete distributions: uniform distributions		RS	
Lecture 12	Discrete distributions: binomial		RS	
Examination	Class Test-1(Tutorial Exam) on Lecturer 1 to Lecturer 12 and Assignment-1		RS	
Lecture 13	Discrete distributions: Poisson	Unit-2	RS	September-3 Classes, August-8 Classes
Lecture 14	Discrete distributions: geometric		RS	
Lecture 15	Discrete distributions: negative binomial		RS	
Lecture 16	Continuous distributions: uniform		RS	
Lecture 17	Continuous distributions: normal		RS	
Lecture 18	Continuous distributions: exponential		RS	
Lecture 19	Joint cumulative distribution function and its properties		RS	
Lecture 20	Joint probability density functions		RS	
Lecture 21	Marginal distributions		RS	
Lecture 22	Conditional distributions		RS	
Examination	Class Test-2(Tutorial Exam) on Lecturer 13 to Lecturer 22 and Assignment-2		RS	
Lecture 23	Expectation of function of two random variables	Unit-3	RS	November-4 Classes, September-7 Classes
Lecture 24	Conditional expectations		RS	
Lecture 25	Independent random variables		RS	
Lecture 26	Bivariate normal distribution		RS	
Lecture 27	Correlation coefficient		RS	
Lecture 27	Joint moment generating function (jmgf)		RS	
Lecture 28	Calculation of covariance (from jmgf),		RS	
Lecture 29	Linear regression for two variables		RS	
Lecture 30	Chebyshevs inequality statement		RS	
Lecture 31	Chebyshevs inequality interpretation of (weak) law of large numbers and strong law of large numbers.		RS	
Lecture 32	Central Limit theorem for independent identically distributed random variables with finite variance.		RS	

Lecture 33	Central Limit theorem for identically distributed random variables with finite variance.		RS	
Examination	Class Test-3(Tutorial Exam) on Lecturer 23 to Lecturer 33 and Assignment-3		RS	
Lecture 34	Random Samples, Sampling Distributions	Unit-4		December-5 Classes, November-8 Classes
Lecture 35	Estimation: Unbiasedness, consistency		RS	
Lecture 36	The method of moments and the method of maximum likelihood estimation,		RS	
Lecture 37	Confidence intervals for parameters in one sample problems of normal populations,		RS	
Lecture 38	Confidence intervals for proportions, problems.		RS	
Lecture 39	Testing of hypothesis: Null and alternative hypotheses tests for one sample problems for normal populations, tests for proportions,		RS	
Lecture 40	The critical and acceptance regions,		RS	
Lecture 41	Two types of error, Neyman-Pearson Fundamental Lemma,		RS	
Lecture 42	Tests for one sample problems for normal populations		RS	
Lecture 43	Tests for proportions		RS	
Lecture 44	Chi-square goodness of fit test		RS	
Lecture 45	Applications of Chi-square goodness of fit test		RS	
Examination	Class Test-4(Tutorial Exam) on Lecturer 1 to Lecturer 45 and Assignment-4		RS	

Reference Books

1. Miller and M. Miller, John E. Freund's Mathematical Statistics with Applications, 7th Ed., Pearson, 2006.
2. S. Ross, Introduction to Probability Models, 9th Ed., Academic Press, 2007.
3. R.B. Ash, Basic Probability Theory, Dover Publications, 2008.
4. R.V. Hogg, J.W. McKean and A.T. Craig, Introduction to Mathematical Statistics, Pear- son, 2007.
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6. Gupta, Groundwork of Mathematical Probability and Statistics, Academic Publisher, 2015.
7. W. Feller, An Introduction to Probability Theory and its Applications, Wiley, 1968.
8. A.P. Baisnab and M. Jas, Elements of Probability and Statistics, McGraw Hill, 1993.
9. V.K. Rohatgi, A.K.Md.E. Saleh, An Introduction to Probability and Statistics, Wiley, 2008.