excel beyond expectancy

CARE Academy

for Competitive Examinations

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UG TRB – MATHS Syllabus

MATHEMATICS

UNIT-1
ALGEBRA and TRIGONOMETRY

Polynomial Equations – Imaginary and Irrational Roots – Relation between Roots and Coefficients symmetric function of Roots in terms of coefficient- Transformation of equation – Reciprocal equation - Increase or Decrease the roots of given equation – Removal of terms – Descartes's rule of signs – Approximate solution of roots of polynomial by Horner's Method–Cardan's method of solution of cubic polynomial – Summation of series using Binomial – Exponentialand Logarithmic series.

Symmetric – Skew symmetric, Hermitian – Skew Hermitian, Orthogonal Matrices, Unitary Matrices – Eigen Values – Eigen Vectors – Cayley-Hamilton Theorem – Similar Matrices – Diagonalization of Matrices.

Prime Number, Composite Number, Decomposition of a Composite Number as a Product of primes uniquely – Divisor of a positive Integer – Euler Function. Congruence Modulo n, Highest power of prime number p Contained in $n!$ – Application of Maxima and Minima – Prime and Composite numbers – Euler's function J(N) – Congruences – Fermat's, Wilson's and Lagrange's theorems.

Expansions of Power of sinnX, cosnX, tannx – Summation by C + i S method, Telescopic Summation - Expansion of sin$x$, cos$x$, tan$x$ in terms of x - Sum of Roots of Trigonometric Equation, Formation of Equation With Trigonometric Roots - Hyperbolic Functions – Relation Between Circular and Hyperbolic Function – Inverse Hyperbolic Function – Logarithm of a complex number – Principal Value and General Values.

UNIT II
DIFFERENTIAL CALCULUS, INTEGRAL CALCULUS and ANALYTICAL GEOMETRY

n^{th} derivatives –Trigonometrical Transformations — Leibnitz Theorem – Implicit functions – Partial Differentiation– Maxima / Minima of a function of two variables – Lagrangian multiplier method - Radius of curvature in Cartesian and Polar forms – Angle between radius vector and tangent – Slope of tangent of a polar curve – p-r equations – Center of Curvature – Evolutes, Envelopes –Asymptotes of Algebraic curves - Asymptotes by inspection – Intersection of a curve with asymptotes.

Evaluation of Double and Triple integrals – Applications of Multiple Integrals in finding volumes, surface areas of solids – Areas of curved surfaces – Jacobians – Transformation of Integrals using Jacobians – Indefinite integrals - Beta and Gamma Functions and their properties – Evaluation of Integrals using Beta and Gamma Functions.

Pole and Polar – Conjugate points and Conjugate lines, Conjugate diameters - Polar Coordinates – General Polar Equation of a Straight line – General Polar Equation of a Conic

UNIT-III DIFFERENTIAL EQUATIONS and LAPLACE TRANSFORMATIONS

Ordinary Differential Equations - Homogeneous Equations - Exact equations - Integrating Factors - Linear equations - Reduction of order – Second order Linear differential equations – General solution of homogeneous Equations – Homogeneous equation with constant coefficients – Method of undetermined coefficients – method of Variation of

Parameters - System of first order equations – Linear systems - Homogeneous linear systems with constant coefficients.

Partial Differential Differential Equations - Formation of Partial Differential Differential Equations by eliminating arbitrary constants and arbitrary functions. Solving PDEs: Complete integral - Singular integral - general integral - Lagrange's equation Pp+Qq=R - Charpit's method and special types of first order equations.

Laplace transform of elementary functions – Laplace transforms of special functions like unit step function. Dirac Delta function – Properties of Laplace Transformation and Laplace Transforms of derivatives and integrals – Evaluation of integrals using Laplace transform - Initial value theorem - Final value theorem – Laplace transform of periodic functions – Inverse Laplace transforms – Convolution theorem – Application of Laplace transformations in solving first and second order linear differential equations and simultaneous linear ordinary differential equations.

UNIT –IV
VECTOR CALCULUS and FOURIER SERIES, FOURIER TRANSFORMS

Vector Differentiation – Velocity and Acceleration – Vector valued functions and Scalar potentials – Gradient – Divergence – Curl – Directional Derivative – Unit normal to a surface – Laplacian double operator – Harmonic functions.

Vector Integration – Line Integral – Conservative force field – Determining Scalar Potential from a conservative force field – Work done by a force – Surface Integral – Volume integral – Theorems of Gauss, Stokes, and Green.

Fourier Series – Expansions of Periodic functions of period 2Œ - Expansion of even and odd functions – half range series – Evaluation of Infinite Series using Fourier Series expansions – Fourier Transforms – Infinite Fourier Transform – Fourier Sine and Cosine transforms – Simple properties of Fourier Transforms – Convolution Theorem – Parseval's identity.

UNIT –V
ALGEBRAIC STRUCTURES

Groups – Subgroups, cyclic Groups and properties of cyclic groups, Lagrange's Theorem – Counting Principles – Normal subgroups, Quotient groups, Homomorphism, Automorphism, Cayley's theorem, Permutation groups – Rings – Some special classes of Rings – Integral domain, Homomorphism of rings – Ideal and Quotient rings – Prime ideal, Maximum Ideals –the field and quotients of an integral domain – Euclidean rings – Algebra of Linear transformation, Characteristic roots, matrices, Canonical forms, Triangular Forms – Problems of converting Linear Transformation to Matrices and vice-versa – Vector Space – Definition and examples – Linear dependence – Independence, Sub spaces and Dual spaces – Inner product spaces.

UNIT-VI
REAL ANALYSIS

Sets – Countable and Uncountable sets – Real Number system R – Functions – Real Valued functions, Equivalence and Countability – Infremum and Supremum of a subset of R – Bolzano- Weierstrass Theorem – Sequences of real numbers – Convergent and Divergent Sequences – Monotone Sequences – Cauchy Sequences – Limit Superior and Limit Inferior of a sequence – Sub Sequences – Infinite series – Alternating Series – Conditional convergence and Absolute convergence – Tests of Absolute convergence – Continuity and Uniform Continuity of a real valued function of a real variable – Limit of a function at a point – Coninuity and Differentiability of real valued functions – Rolle's Theorem – Mean Value Theorems – Inverse function theorem, Taylor's Theorem with remainder forms – Power series expansion – Riemann Integrability – Sequences and Series of Functions.

Metric spaces – Limits of a function at a point in metric spaces – functions continuous on

a metric space – various reformulations of continuity of a function in a metric space - open sets – closed sets – discontinuous functions on the real line.

UNIT VII
COMPLEX ANALYSIS

Algebra of Complex Numbers – Function of Complex Variable – Mappings, Limits – Theorems on Limits, continuity, differentiability – Cauchy-Riemann Equations – Analytic Functions – Harmonic Function – Conformal mapping – Mobius Transformations – Elementary Transformation – Bilinear Transformations – Cross ratio – Fixed points of bilinear transformations – Special Bilinear transformations.

Contours – Contour Integrals – Anti Derivatives – Cauchy-Goursat Theorem- Power Series – Complex Integration – Cauchy's theorem, Morera's theorem, Cauchy's Integral Formula – Liouville's Theorem – Maximum Modulus Principle – Schwarz's Lemma – Taylor's series – Laurent's series – Calculus of Residues – Residue Theorem – Evaluation of Integrals - Definite integrals of Trigonometric functions – Argument principle and Rouche's Theorem.

UNIT VIII
MECHANICS

Statics: Forces on a rigid body –Moment of a force – General motion of a rigid body – Equivalent system of force – Parallel Forces – Forces along the sides of Triangle Couples.

Resultant of several coplanar forces – Equation of line of action of the resultant – Equilibrium of rigid body under three Coplanar forces – Reduction of Coplanar forces into single force and couples – Laws of friction, angle of friction, Equilibrium of a body on a rough inclined plane acted on by several forces – Equilibrium of a uniform Homogeneous string – Catenary – Suspension bridge – Centre of Gravity of uniform rigid bodies.

Dynamics: Velocity and Acceleration – Coplanar motion – Rectilinear motion under constant forces – Acceleration and retardation thrust on a plane – Motion along a Vertical line under gravity – Motion along an inclined plane – motion of connected particles – Newton's Laws of motion.

Work, Energy and power – Work – Conservative field of force – Power –Rectilinear motion under varying force Simple Harmonic Motion (S.H.M) – S.H.M along a horizontal line – S.H.M along a Vertical line – Motion under gravity in a resisting medium.

Path of a projectile – Particle projected on an inclined plane – Analysis of forces acting on particles and rigid bodies on static equilibrium, equivalent systems of forces, friction, centroids and moments of inertia – Elastic Medium, Impact – Impulsive force – Impact of sphere – Impact of two smooth spheres – Impact of two spheres of two smooth sphere on a plane – oblique impact of two smooth spheres.

Circular motion – Conical Pendulum motion of a cyclist on circular path – Circular motion on a vertical plane – relative rest in revolving cone – simple pendulum – Central Orbits – Conic as Centered Orbit – Moment of inertia

UNIT IX
OPERATIONS RESEARCH

Linear Programming – Formulation – Graphical Solution – Simplex Method – Big –M method – Two phase method – Duality – Primal dual relation – dual simplex method – revised simplex method – Sensitivity analysis – Transportation Problem – Assignment Problem – Queuing Theory – Basic Concepts – Steady State analysis of M/M/1 and M/M/ Systems with infinite and finite capacities.

PERT-and CPM – Project network diagram – Critical path – PERT computations-Inventory Models- Basic Concept –EOQ Models – uniform Demand rate infinite and finite protection

rate with no shortage – Classical newspaper boy problem with discrete demand – purchase inventory model with one price brake – Game theory – Two person Zero – Sum game with saddle point – without saddle point – Dominance – Solving 2xn or mx2 game by graphical method – Integer programming – Branch and bound method

UNIT—X
STATISTICS/PROBABILITY

Measures of central tendency – Measures of Dispersion – Moments – Skewness and Kurtosis – Correlation – Rank Correlation – Regression – Regression line of x on y and y on x – Index Numbers – Consumer Price Index numbers – Conversion of chain base Index Number into fixed base index numbers – Curve Fitting – Principle of Least Squares – Fitting a straight line – Fitting a second degree parabola – Fitting of power curves – Theory of Attributes – Attributes – Consistency of Data – Independence and Associate of data.

Theory of Probability – Sample Space – Axioms of Probability – Probability function – Laws of Addition – Conditional Probability – Law of multiplication – Independent – Boole's Inequality – Bayes' Theorem – Random Variables – Distribution function – Discrete and continuous random variables – Probability density functions – Mathematical Expectation – Moment Generating Functions – Cumulates – Characteristic functions – Theoretical distributions – Binomial, Poisson, Normal distributions – Properties and conditions of a normal curve – Test of significance of sample and large samples – Z- test – Student's t-test – F-test – Chi square and contingency coefficient.