

CONTENTS

	<i>Page</i>		<i>Page</i>
PREAMBLE	9		
1. FOREWORD	10		
2. GUIDE TO THE SYLLABUS	11 – 13		
3. SYLLABUS	14 – 155		
Topic Area I Vectors and Mechanics			
Unit 1 Vectors	14 – 31		
1.1 Basic Knowledge		1.11	(c) Integration of a vector function with respect to a scalar variable
1.2 Vector Addition		1.12	Vectors in Polar Coordinates
(a) Triangle Law and parallelogram law			Application of Vectors
(b) Properties of vector addition			(a) Force as a Vector
(i) Commutative law			(b) Kinematics in R^2
(ii) Associative law		Unit 2	Statics and Friction
1.3 Zero Vector, Negative Vector and Vector Subtraction		2.1	Forces, Resultant and Resolution of Forces
1.4 Scalar Multiple and its Properties		2.2	Resultant of Parallel Forces, Moments and Couples
(a) Associative law		2.3	Equilibrium of a System of Coplanar Forces
(b) Distributive laws		2.4	Nature of Friction
1.5 Components of Vectors			(a) Laws of friction
(a) Resolution of vectors			(b) Angle of friction
(b) The unit vectors \hat{i} , \hat{j} and \hat{k} and the resolution of vectors in the rectangular coordinate system		2.5	Equilibrium of Rigid Bodies
(c) Direction ratios and direction cosines		Unit 3	Kinematics
1.6 Position Vectors and Vector Equation of a Straight Line		3.1	Displacement, Velocity and Acceleration
1.7 Scalar Product		3.2	Angular Displacement, Angular Velocity and Angular Acceleration
(a) Definition		3.3	Resultant Velocity
(b) Properties of scalar product		3.4	Relative Motion
(c) Scalar product in Cartesian components		3.5	Resolution of Velocity and Acceleration Along and Perpendicular to Radius Vector
(d) Orthogonality		Unit 4	Newton's Laws of Motion
1.8 Vector Product		4.1	Newton's Laws of Motion
(a) Definition		4.2	Rectilinear Motion of a Particle under Variable Forces
(b) Properties of vector product		Unit 5	Momentum, Work, Energy, Power and Conservation Laws
(c) Vector product in Cartesian components		5.1	Momentum and Conservation of Momentum
(d) Perpendicular vectors and parallel vectors		5.2	Work, Energy, Power and Conservation of Energy
1.9 Triple Product		Unit 6	Impact
(a) Scalar triple product		6.1	Impulse
(b) Vector triple product		6.2	Impact of Elastic Bodies
1.10 Vector Function, Differentiation and Integration		6.3	Direct Impact
(a) Vector as a function of a scalar variable		6.4	Impact of a Smooth Sphere on Smooth Surface
(b) Differentiation of a vector function with respect to a scalar variable		6.5	Oblique Impact
		Unit 7	Motion of a projectile under Gravity
		7.1	Motion of Projectile
		7.2	Trajectory of Projectile
		7.3	Range on an Inclined Plane
		7.4	Further Application of Projectile
		Unit 8	Circular Motion
		8.1	Circular Motion
		8.2	Motion in a Vertical Circle

	<i>Page</i>		<i>Page</i>
Unit 9 Simple Harmonic Motion	71 – 76	13.5 Reduction of Equations to Second Order Differential Equations with Constant Coefficients	
9.1 Simple Harmonic Motion		13.6 Systems of two First Order Differential Equations	
9.2 Damped Oscillation		13.7 Applications in Practical Problems	
9.3 Forced Oscillation		Topic Area III Numerical Methods	
Unit 10 Motion of a Particle in a Plane	77 – 79	Unit 14 Interpolation and Lagrange Interpolating Polynomial	105 – 108
10.1 Motion of a Particle in a Plane		14.1 Interpolation and Interpolating Polynomials	
Unit 11 Motion of a Rigid Body	80 – 91	14.2 Construction of Lagrange Interpolating Polynomials	
11.1 Centre of Mass		14.3 Use of Lagrange Interpolating Polynomial	
(a) Introduction		14.4 Error Estimation of Interpolating Polynomial	
(b) Centre of mass by integration		Unit 15 Approximation	109 – 113
(c) Centre of mass of a composite body		15.1 Treatment of Errors; their Estimation and Algebraic Manipulation	
11.2 Moment of Inertia		(a) Three basic types of errors	
(a) Introduction		(i) Inherent error	
(b) Moment of inertia by integration		(ii) Truncation error	
(c) Parallel and perpendicular axes theorem		(iii) Round-off error	
(d) Moment of inertia of a composite body		(b) Absolute and relative error	
11.3 Motion of a Rigid Body about a Fixed Axis		(c) Estimation of errors	
(a) Conservation of energy		(d) Combining errors	
(b) Law of angular momentum		15.2 Approximation of Functional Values using Taylor's Expansion	
(c) Applications		(a) Taylor's series expansion of a function	
11.4 General Motion of a Rigid Body		(b) Error estimation	
(a) Introduction		Unit 16 Numerical Integration	114 – 118
(b) Equation of Motion		16.1 Numerical Integration	
(c) Rolling and sliding		16.2 Trapezoidal Rule	
(d) General expression of the kinetic energy of a rigid body		(a) Derivation of the trapezoidal rule	
Topic Area II Differential Equations		(b) Estimation of the error	
Unit 12 First Order Differential Equations and its Applications	92 – 97	(c) Application of trapezoidal rule	
12.1 Basic Concepts and Ideas		16.3 Simpson's Rule	
12.2 Formation of Differential Equations		(a) Derivation of Simpson's rule	
12.3 Solution of Equations with Variables Separable		(b) Estimation of the error	
12.4 Solution of Linear Differential Equations		(c) Application of Simpson's rule	
12.5 Solution of Equations Reducible to Variables Separable Type or Linear Type		Unit 17 Numerical Solution of Equations	119 – 125
Unit 13 Second Order Differential Equations and its Applications	98 – 104	17.1 Method of Fixed-point Iteration	
13.1 Classification of Types		(a) Algorithm of the method	
13.2 Principle of Superposition		(b) The condition of convergence	
13.3 Solution of Homogeneous Equations with Constant Coefficients		(c) Estimation of error	
13.4 Solution of Non-homogeneous Equations with Constant Coefficients		17.2 Newton's Method	
(a) Complementary function and particular integral		(a) Algorithm of the method	
(b) Method of undetermined coefficients		(b) The condition of convergence and error estimation	
		(c) Application of Newton's method	

	<i>Page</i>
17.3 Secant Method	
(a) Derivation of the secant method	
(b) Application of the secant method	
17.4 Method of False Position	
(a) Derivation of the method of false position	
(b) Application of the method of false position	
Topic Area IV Probability and Statistics	
Unit 18 Introductory Probability Theory	126 – 131
18.1 Basic Definitions	
18.2 Ways of Counting	
18.3 Probability Laws	
18.4 Bayes' Theorem	
18.5 Recurrence Relation	
Unit 19 Basic Statistical Measures	132 – 133
19.1 Basic Knowledge	
19.2 Calculation of Mean	
19.3 Calculation of Standard Deviation and Variance	
Unit 20 Random Variables, Discrete and Continuous Probability Distribution	134 – 147
20.1 Random Variable	
(a) Discrete probability function	
(b) Probability density function	
20.2 Expectations and Variances	
20.3 Binomial Distribution	
(a) Binomial trials, Binomial probability	
(b) Binomial distribution	
(c) Applications	
20.4 Normal Distribution	
(a) Basic definitions	
(b) Standard normal curve and the use of normal table	
(c) Applications	
(d) Binomial approximated to normal distribution	
20.5 Linear Combination of Independent Normal Variables	
Unit 21 Statistical Inference	148 – 155
21.1 Basic Concept	
21.2 Estimation of a Population Mean from a Random Sample	
21.3 Confidence Interval for the Mean of a Normal Population with Known Variance	
21.4 Hypothesis Testing	
21.5 Type I and Type II Errors	
APPENDIX: MATHEMATICS REFERENCE BOOKS	156 – 173