FACULTY OF SCIENCES

SYLLABUS
of
Bachelor of Science (Honours) Mathematics
(Semester: I -VI)

(Under Continuous Evaluation System)

Session: 2021-22

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR (Autonomous)

Bachelor of Science (Honours) Mathematics
Session: 2021 -22
Programme Specific Outcomes

Upon successful completion of this course, students will be able to:

PSO1: Solve complex Mathematical problems by critical understanding, analysis and synthesis. Students will also be able to provide a systematic understanding of the concepts and theorem of Mathematics and their applications in the real world to an advanced level, enhance career prospects in a huge array of field suitable to succeed at an entry level position in Mathematics post graduate program.

PSO2: Demonstrate proficiency in Mathematics and the Mathematical concepts needed for a proper understanding of Physics, Chemistry, Electronics, Computer Science and Economics.

PSO3: Create and develop Mathematical software application using a systematic approach & apply discrete Mathematical concept to practical application.

PSO4: Demonstrate knowledge of Calculus I & II, Matrices and Theory of Equations, Analytical and Solid Geometry, Statics & Tensor Calculus and able to apply this knowledge to analyze a variety of Mathematical Phenomena.

PSO5: Demonstrate knowledge of physical chemistry & apply this knowledge to analyze a variety of chemical phenomena & will be able to interpret and analyze quantitative data.

PSO6: Understand and demonstrate the knowledge of Mechanics, area, volume and displacement with differential equation of the orbit.

PSO7: Understand the basic concepts and basic principles of Demand and Supply, Measurement of Price Elasticity of Demand and apply Economic theories to derive cost function from Production Function.

PSO8: Learn implications of Revenue curves and their mutual relationships.

PSO9: Develop statistical approach and mathematical thinking among students to problem solving on a diverse variety of disciplines.

PSO10: Have knowledge of computer fundamentals, able to handle practical programming problems using C and analyze large volume of data using various statistical techniques

Kanya MahaVidyalaya, Jalandhar(Autonomous)

Scheme and Curriculum of Examinations of Three Year Degree Programme
Bachelor of Science (Honours) Mathematics Semester-I
Session- 2021-22

Bachelor of Science (Honours) Mathematics Semester-I							
Course Code	Course type	Course Title	Max.Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-1421/ BOML-1031/ BOML-1431	C	Punjabi (Compulsory) [1] Basic Punjabi/ [2] Punjab History and Culture	50	40	-	10	3
BOML-1102	C	Communication Skills in English	50	40	-	10	3
BOML-1333	C	Calculus-I	100	80	-	20	3
BOML-1334	C	Coordinate Geometry	100	80	-	20	3
BOMM-1085 OR BOML-1175	C C	[4] Physical Chemistry OR [3]Micro Economics-I	100 100	60 80	*20* -	20 20	3+3 3
BOML-1336 OR BOMM-1396	C C	[3] Statics OR [4]Mechanics	100 100	80 60	- 20	20 20	3 3+3
AECD-1161	AC	[*] Drug Abuse: Problem, Management and Prevention (Compulsory)	50	40	-	10	3
SECF-1492	AC	[*]Foundation Course	25	20	-	5	1
Total Marks			500				

Note:
[1] Special Course in lieu of Punjabi (Compulsory)
[2] Special Course in lieu of Punjabi (Compulsory) for those students who are not domicile of Punjab.
[3] Only those students can opt these courses who have not studied Chemistry at +2 level.
[4] Only those students can opt these courses who have studied Chemistry at +2 level.
[*] Marks of these papers will not be added in total marks. Grades will be provided.
C-Compulsory
AC-Audit Course

Bachelor of Science (Honours) Mathematics
Semester–I
Session- 2021-22
Course Title: Calculus-I
Course Code: BOML-1333

Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand real number system, lub&glb of set of real numbers, limit of a function, basic properties of limit & to apply it in real world problem.

CO 2: Analyses continuous and discontinuous function, Apply concept of continuity in uniform continuity.

CO 3: Demonstrate Asymptotes, points of inflexion, multiple points on a curve & also to differentiate between concavity and convexity & hence tracing of curve.

CO 4: Apply reduction formula on different functions & to apply in a wide variety of disciplines like Bio, Eco, Physics & Engineering.

CO 5 : To understand the concepts of Riemann sum, partitions, upper and lower sums, Riemann integrability of continuous functions and of monotone functions.

CO 6: To Classify the difference between increasing and decreasing functions.

Bachelor of Science (Honours) Mathematics
Semester–I
Session-2021-22
Course Title: Calculus-I
Course Code: BOML-1333

Examination Time: 3 Hours Max. Marks: 100
Theory: 80
CA:20

Instructions for Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the fourSections (A-D). Questions of Sections A-D should be set from Units I-IV of thesyllabus respectively. Questions may be subdivided into parts (not exceeding four).Candidates are required to attempt five questions, selecting at least one questionfrom each section. The fifth question may be attempted from any Section.

Unit I

Real line, intervals, l.u.b. and g.l.b., the l.u.b. property of real numbers and order properties of real numbers , Archimedean property, definition of the limit of a function of real variable, algebra of limits,continuity, classification of discontinuities

Unit II

Differentiability of functions of real variable, increasing and decreasing functions, maxima and minima, mean values theorems

Unit III

Intermediate-value theorems, Asymptotes, concavity and convexity, points of inflexion, curve tracing .

Unit IV

Anti derivative of function of real variable, Riemann sums, definite integrals and their properties, the fundamental theorem of calculus, applications to length of arc and area bounded between curves, Reduction Formulae.

Text Book:
George B. Thomas and Ross L. Finney,Calculus and Analytic Geometry, 9th E
Reference Books:
1. A.D.R. Choudary and C.P. Niculescu, Real Analysis on Intervals, Springer, 2014. (Chapter 1).
2. Kreyszig, E., Advanced Engineering Mathematics.
3. Ghorpade, Sudhir R., Limaye, BalmohanV. ,A Course in Calculus and Real Analysis.

Bachelor of Science (Honours) Mathematics
Semester–I
Session- 2021 -22
Course Title: Coordinate Geometry
Course Code: BOML-1334

Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of the geometry of lines and conics in the Euclidian plane.

CO 2: Develop geometry with a degree of confidence and will gain fluency in the basics of Euclidian geometry.

CO 3: Sketch conic sections; identify conic sections, their focal properties and classifications.

CO 4: Demonstrate the concept of parabola, ellipse, hyperbola, sphere and the general quadratic equation.

CO 5: Understand the concept of coordinate geometry on a wider scale with the help of shifting of origin and rotation of axis.

Bachelor of Science (Honours) Mathematics
Semester–I
Session 2021 -22
Course Title: Coordinate Geometry
Course Code: BOML-1334

Examination Time: 3 HoursMax. Marks: 100
Theory: 80
CA:20
Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of thesyllabus respectively. Questions may be subdivided into parts (not exceeding four).Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The question paper must contain 30% of the article/theory from the syllabus.

Unit I

Pair of Straight lines: Joint equation of pair of straight lines and angle between them,condition of parallelism and perpendicularity, joint equation of the angle bisectors, joint equation of lines joining origin to the intersection of a line and a curve.

Unit II

Circle: General equation of circle, circle through intersection of two lines, tangent andnormal, Chord of contact, pole and polar, pair of tangents from a point, equation of chord in midpoint form, angle of intersection and orthogonality, power of a point w.r.t circle, radical axis, co-axial family of circles, limiting points.

Unit III

Conic sections: Parabola, ellipse and hyperbola, tangent and normal, chord of contact, poleand polar of tangent from a point, equation of chord in terms of midpoint, diameter, conjugate diameters of ellipse and hyperbola, conjugate hyperbola, asymptotes of hyperbola, rectangular hyperbola.

Unit IV

Transformation of axes in two dimensions: shifting of origin, rotation of axes, the seconddegree equation $S=ax^2+2hxy+by^2+2gx+2fy+c=0$, its invariants t, Δ, and O. Reduction of the second degree equation into standard form. Identification of curves represented by S=0 (including pair of lines).Polar coordinates: Polar equations of straight lines, circles and conics.

Text Book:
Loney, S.L., The Elements of Coordinate Geometry, London, Macmillan

Reference Book:
P.K Jain and Khalil Ahmed, Text book of Analytical Geometry, New Age International Publishers

Bachelor of Science (Honours) Mathematics
Semester–I
Session-2021 -22
Course Title: Statics
Course Code: BOML-1336

Course Outcomes

After passing this course, the students will be able to:

CO 1: Apply parallelogram law of forces, triangle law of forces, Lami's theorem to real life problems.

CO 2: Understand that how one can resolve number of coplanar forces, parallel forces and concurrent forces acting at a body.

CO 3: Find the moments of number of coplanar forces acting at a particle

CO 4: Find the resultant of a force and couple acting on a body.

CO 5: Find the applications of CG of a rod, triangular lamina, solid hemisphere, hollow hemisphere, solid cone and hollow cone.

Bachelor of Science (Honours) Mathematics
Semester-I
Session 2021 -22
Course Title: Statics
Course Code: BOML-1336

Examination Time: 3 Hours

Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The question paper must contain 30% of the article/theory from the syllabus.

Unit I
Composition and resolution of forces (parallelogram law, triangle law, polygon law, Lami's Theorem, (ג-µ) theorem). Resultant of a number of coplanar forces.

Unit II
Parallel forces, Moments, Varignon'stheorem of moments, Couples, Resultant of two Coplanar Couples, Equilibrium of two coplanar couples, Resultant of a force and a couple.

Unit III
Equilibrium of a rigid body acted on by three forces in a plane, General Conditions of equilibrium of a rigid body acted on by forces in one plane.

Unit IV
Friction, Laws of friction, Equilibrium of a particle on a rough plane. Centre of Gravity: Centre of gravity of a rod, triangular lamina, solid hemisphere, hollow hemisphere, solid cone and hollow cone.

Text Book:
S.L. Loney,The Elements of Statics and Dynamics Part-I Statics.

Kanya MahaVidyalaya, Jalandhar(Autonomous)

Scheme and Curriculum of Examinations of Three-Year Degree Programme
Bachelor of Science (Honours) Mathematics Semester-II
Session 2021-22

Bachelor of Science (Honours) Mathematics Semester-II							
Course Code	Course type	Course Title	Max.Marks				Examinatio time in hou
			Total	Ext.		CA	
				L	P		
BOML-2421/ BOML-2031/ BOML-2431	C	Punjabi (Compulsory)/ Basic Punjabi/ Punjab History and Culture	50	40	-	10	3
BOMM-2102	C	Communication skills in English	50	25	15	10	3
BOML-2333	C	Calculus-II	100	80	-	20	3
BOML-2334	C	Matrices and Theory of Equations	100	80	-	20	3
BOML-2335	C	Solid Geometry	100	80	-	20	3
BOML-2336 OR BOMM-2396	C C	[1]Dynamics OR [2]Modern Physics-I	100 100	80 60	- 20	20 20	3 3+3
BOMM-2137	C	Computer Fundamentals and Introduction to 'C' Language	100	50	30	20	3+3
AECD-2161	AC	[*]Drug Abuse : Problem, Management and Prevention (Compulsory)	50	40	-	10	3
SECM-2502	AC	[*]Moral Education	25	20	-	5	1
		Total Marks	600				

Note:
[1] Only those students can opt these courses who have not studied Chemistry at +2 level.
[2] Only those students can opt these courses who have studied Chemistry at +2 level.
[*] Marks of these papers will not be added in total marks. Grades will be provided.

C-Compulsory
AC-Audit Course

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Calculus-II
Course Code: BOML-2333

Course Outcomes

After passing this course, the students will be able to:

CO 1: Demonstrate an understanding of limits and how they are used in sequences and series.

CO 2: Know and describe the converging behaviour of Power series and Taylor series.

CO 3: Distinguish between the absolute convergence and conditional convergence.

CO 4: Manage to solve the problem related to Fourier series expansion, Fourier series for even and odd functions and half range series.

Bachelor of Science (Honours) Mathematics Semester–II
Session: 2021-22
Course Title: Calculus-II
Course Code: BOML-2333

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setter: Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Sequence, sub sequence, bounded sequences, monotone sequences, convergence, Cauchy criterion, algebra of limit of sequences (proofs with ε-N rigor), Sandwich Theorem

Unit-II

Infinite series, Sequences of partial sums, convergence of series, series of non-negative terms, comparison tests, Cauchys' Integral test. Ratio test, Raabe's test, logarithmic test and Gauss test (all tests with proofs).

Unit-III

Alternating series, absolute and conditional convergence, Leibnitz Theorem, Convergence of Power Series, Taylor Series, Error estimates

Unit-IV

Periodic functions, trigonometric series, Fourier series expansion, Fourier series for even and odd functions, half range series.

Text Books:

1.Malik, S. C. and Savita Arora, Mathematical Analysis, 3rd Edition. New Age International Publishers, 2008.
2.George B. Thomas and Ross L. Finne, Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998.

Reference Books:

1. Ghorpade Sudhir R. and Limaye B.V., A course in calculus and real analysis, Springer, 2006.
2.Kreyszig Erwin, Advanced Engineering Mathematics, 9th edition, Wiley India Edition, 2011.

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Matrices and Theory of Equations
Course Code: BOML-2334

Course Outcomes

After passing this course, the students will be able to:

CO 1: Distinguish between solution of cubic equations and Bi-quadratic equations.

CO 2: Explain how all polynomials can be broken down by using Fundamental Theorem of Algebra to provide structure for abstraction into fields like Modern Algebra.

CO 3: Understand the concept of matrix congruence of skew symmetric matrices and its reduction in real field.

CO 4: Solve system of linear equations and obtain Eigen values, Eigen vectors, minimal and characteristic equation of a matrix and to apply it in advanced dynamics and electric current.

CO 5: To find the relations between the roots and coefficients of general polynomial equation in one variable.

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Matrices and Theory of Equations
Course Code: BOML-2334

Examination Time: 3 Hours Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setter: Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Hermitian,Skew-Hermitian, Orthogonal and Unitary matrices, Linear independence/dependence of row and column vectors, Elementary operations on matrices, Inverse of a matrix using Gauss Jordan method, Row rank, column rank and their equivalence, System of linear equations and conditions for consistency

Unit-II

Eigen values, Eigen vectors and the characteristic equation of a matrix, Cayley-Hamilton Theorem and its applications, Polynomials, zeros of a polynomial, division algorithm, greatest common divisor, repeated roots, equal roots, unique factorization of polynomials over fields, The fundamental theorem of algebra.

Unit-III

Relationship between roots and the coefficients, Fundamental theorem of symmetric polynomials (without proof). Evaluation of symmetric functions of roots, Rational roots of polynomials with integral coefficients. Descartes rule of sign.

Unit-IV

Strum's theorem (statement only), Solution of cubic equation using Cardano's method, and biquadratic equation by Descartes method and Ferrari's method.

Text Book:

Romesh Kumar,Algebra & Trigonometry, Pardeep publication.

Reference Books:

1. A. Kurosh,Higher Algebra, (Moscow Mir Publisher 1972).
2. R.N. Gupta, Surjeet Singh and R.J. Hans-Gill, Theory of Equations. (Lecture notes for inter University Leadership project in Mathematics.)
3. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd., New Delhi-2000.
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, First course in Linear Algebra, Wiley Eastern, New Delhi 1983.
5. Shanti Narayan &P.K.Mittal, A Text Book of Matrices, S.Chand& Co. Ltd., New Delhi, Reprint 2002.
6. J. Gilbert & L. Gilbert, Linear Algebra and Matrix Theory, Academic Press.

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Solid Geometry
Course Code: BOML-2335

Course Outcomes

After passing this course, the students will be able to:

CO 1: Demonstrate the concept of cone, classification of cone, intersection of line and cone, reciprocal cone.

CO 2: Understand the concept of cylinder, enveloping cylinder and its limiting form.

CO 3: Describe the concept of conicoids or quadratic surface, its classification, trace different types of conicoids.

CO 4: Manage to find surface of revolution and concept of tangent and normal to the conicoid

CO 5: Identify the conicoids and representing it in the form of hyperboloid, ellipsoid, paraboloid.

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Solid Geometry
Course Code: BOML-2335

Examination Time: 3 Hours Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setter: Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The question paper must contain 30% of the article/theory from the syllabus.

Unit-I

Intersection of three planes, condition for three planes to intersect in a point or along a line or to form a prism, change of axes, shift of origin, rotation of axes, sphere and section of a sphere by a plane. Sphere through a given circle. Intersection of a line and sphere.

Unit-II

Tangent and normal, tangent plane, angle of intersection of two spheres and condition of orthogonality, power of a point w.r.t. a sphere, Radical planes, radical axis, radical centre, coaxial family of spheres, limiting points.

Unit-III

Cylinder: Cylinder as surface generated by a line moving parallel to a fixed line and through fixed curve. Right circular cylinder, enveloping cylinder, Cone: homogeneous equation of cone in second degree in x,y,z, Quadratic cone, reciprocal cone, right circular cone, enveloping cones.

Unit-IV

Surface of revolution, Identification of quadratic surfaces: Ellipsoid, hyperboloid, paraboloid.

Text Book

1. P.K Jain and Khalil Ahmed, A text book of Analytical Geometry of three dimensions, Wiley Eastern Ltd, 1999.

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Dynamics
Course Code: BOML-2336

Course Outcomes

After passing this course, the students will be able to:

CO 1: Identify the basic relations between distance, time, velocity and acceleration.
CO 2: Explain the relationship between forces and motion. Differentiate between balanced and unbalanced forces and Explain how unbalanced force affect motion.
CO 3: Understand Newton's Laws of Motion and Apply the laws to solve many problems.
CO 4: Discuss the motion of particles connected by a string, motion along a smooth inclined plane.
CO 5: Solve different types of problems with Variable Acceleration.
CO 6: Discuss Simple Harmonic Motion and Illustrate it with a variety of examples.
CO 7: Solve Pendulum, Damped and forced Oscillations oscillating system problems.
CO 8: Define Work, Power and Energy and Explain their relationship. Use measurement tools to apply the concepts of Work and power to solve real life problems.
CO 9: Define Energy and Identify the different types that exist

Bachelor of Science (Honours) Mathematics Semester–II
Session 2021-22
Course Title: Dynamics
Course Code: BOML-2336

Examination Time: 3 Hours Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setter: Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The question paper must contain 30% of the article/theory from the syllabus.

Unit-I

Rectilinear motion in a straight line with uniform acceleration, Newton's laws of motion. Motion of two particles connected by a string.

Unit-II

Motion along a smooth inclined plane. Variable acceleration. Simple Harmonic Motion.

Unit-III

Curvilinear motion of particle in a plane, Definition of velocity and acceleration, projectiles. Oscillations: Free Vibrations, Simple Pendulum, Conical Pendulum.

Unit-IV

Work, Power and Energy: Kinetic and Potential energy, Conservative forces. Theorem of conservation of energy. Work done against gravity.

Text Book:

S.R.Gupta, A text book of Dynamics.

Reference Books:

1. F. Chorlton, Dynamics.
2. S.L. Loney, An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Cambridge University Press, 1956.

Kanya Maha Vidyalaya, Jalandhar(Autonomous)

Scheme and Curriculum of Examinations of Three-Year Degree Programme
Bachelor of Science (Honours) Mathematics
Semester-III
Session- 2021-22

Bachelor of Science (Honours) Mathematics Semester-III								
Sr. No.	Course Code	Course type	Course Title	Max.Marks				Examination Time in hours
				Total	Ext.		CA	
					L	P		
1	BOML-3331	C	Calculus III	100	80	-	20	3
2	BOML-3332	C	Ordinary Differential Equations and Special Functions	100	80	-	20	3
3	BOML-3333	C	Probability Theory	100	80	-	20	3
4	BOML-3334	C	Linear Algebra	100	80	-	20	3
5	BOMM-3135	C	Python Programming	100	50	30	20	3+3
6	AECE-3221	AC	* Environmental Studies (Compulsory)	100	60	20	20	3
7	SECP-3512	AC	* Personality Development	25	20	-	*5*	1
Total Marks				500				

Note:

C-Compulsory
AC-Audit Course

* Marks of these papers will not be added in total marks and only grades will be provided

Bachelor of Science (Honours) Mathematics
Semester–III

Session- 2021-22

Course Title: Calculus III

Course Code: BOML-3331

Course Outcomes

After passing this course, the students will be able to:

CO1: Evaluate Partial derivatives and recognize the various notations used r partial derivatives.

CO2: To find optimization value for a function of several variables.

CO3: Apply double integration technique in finding the area of a region.

CO4: Recognize the appropriate tools of calculus to solve applied problems.

CO5: Analyze functions using limit, continuity, derivative and integration

Bachelor of Science (Honours) Mathematics
Semester–III
Session- 2021-22
Course Title: Calculus III
Course Code: BOML-3331

Examination Time: 3 Hours Max. Marks:100
Theory: 80
CA:20

Instructions for Paper Setter:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one questions from each section. The fifth question may be attempted from any Section.

Unit I

Real Valued functions of several variables with emphasis on functions of two variables, Limits and continuity, Partial derivatives, Homogenous Functions, Euler's Theorem

Unit II

Total differentiation, Differentiation of composite functions, Implicit functions, Chain Rule, Jacobians, Directional Derivatives, Gradient Vectors.

Unit III

Saddle Points, Maxima and Minima of functions of two variables, Lagrange's Multipler method, Higher dimensional analogues of Lagrange's Mean value Theorem and Taylor's theorem for functions of twovariables.

Unit IV

Double integration over rectangular and non-rectangular regions, change of order of integration, double integration in polar co-ordinates, triple integration over parallelepiped and other solid regions, Applications of double and triple integrals to area, volume, centre of gravity, moment of inertiaetc.

Text Book:
George B. Thomas and Ross L. Finney: Calculus and Analytic Geometry, 9th Edition, Addison Wesley, 1998. (Scope as inCh.12-13)

Reference Books:
1. Kreyszig, E.: Advanced Engineering Mathematics.
2. Ghorpade, Sudhir R., Limaye, BalmohanV. :A Course in Calculus and Real Analysis.

Bachelor of Science (Honours) Mathematics Semester–III

Session- 2021 -22

Course Title: Ordinary Differential Equations and Special Functions

Course Code: BOML-3332

Course Outcomes

After passing this course, the students will be able to:

CO1: Demonstrate the concept Of Linear Differential equation with constantand variable coefficients

CO2: Apply in wide variety of disciplines Physics, Biology, Economics

CO3: Manage to solve the problems related to series solution of Differential equationby power series method.

CO4: Understand the Bessel function and their application to physical world

CO5: Understand the Legendre function and their application to physical world

Bachelor of Science (Honours) Mathematics
Semester–III

Session- 2021-22

Course Title: Ordinary Differential Equations and Special Functions

Course Code: BOML-3332

Examination Time:3Hours Max. Marks:100

Theory: 80

CA:20

Instructions for Paper Setter:
Eight questions of equal marks (16 marks each) are to be set, two in each of the fourSections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit –I

Exact differential equations. First order and higher degree equations solvable for *x, y, p*. Clairaut's form and singular solutions. Geometrical meaning of a differential equation. Orthogonal trajectories. Linear differential equations with constantcoefficients.

Unit II

Linear differential equations with variable coefficients, Variation of Parameters method, reduction method, series solutions of differential equations. Power series method, Bessel and Legendre equations (only series solution).

Unit III

Bessel's Functions: Recurrence relations, Generating Function, Orthogonal Property,Trigonometric Expansions involving Bessel's Functions.

Unit –IV

Legendre's Functions: Recurrence Relations, Generating Function, Rodrigue's Formula, Orthogonal Property, Trigonometric Series, Laplace definite integrals, Christoffel's expansion

Text Book:
M.D Raisinghania: Ordinary and Partial Differential Equations. S Chand Publication

Reference Books:

1.D.A. Murray: Introductory Course in Differential Equations. Orient Longman (India), 1967.
2.G.F. Simmons: Differential Equations, Tata McGraw Hill,1972.
3.E.A. Codington: An Introduction to Ordinary Differential Equations, Prentice Hall of India,1961.
4.F.D. Rainville: SpecialFunctions

Bachelor of Science (Honours) Mathematics

Semester–III

Session- 2021-22

Course Title: Probability Theory

Course Code: BOML-3333

Course Outcomes

After passing this course, the students will be able to:

CO1: Find the probability of single event and compound and complimentary event

CO2: Contrast discrete and continuous random variable

CO3: Apply general Properties of expectation and variance

CO4: Differentiate between the events with Binomial and Poisson distribution

CO5: Apply Normal distribution in real time applications

CO6: Translate the real world problem into probability based mathematical model

CO7: Identify the characteristics of different continuous and discrete distribution

CO8: Use different distributions to solve practical problems

Bachelor of Science (Honours) Mathematics
Semester–III
Session 2021-22
Course Title: Probability Theory
Course Code: BOML-3333

Examination Time:3Hours | Max. Marks:100
Theory: 80
CA: 20

Instructions for Paper Setter:Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section. The students can use only Non Programmable& Non Storage Type Calculator and statistical tables.
The question paper must contain 30% of the article/theory from the syllabus.

Unit I

Measures of central tendency: Mean, Median, Mode, and Measure of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation, Variance, Skewness, Kurtosis, Sample Space, Probability axioms, Probability on finite sample space, Conditional probability and Independence, Baye's theorem.

Unit II

Random variables, Probability mass function, Probability density function, Distribution function, Function of a random variable and its distribution. Multiple random variables, Joint distribution, Marginal and Conditional distributions.

Unit III

Mathematical Expectation, Conditional Expectation, Variance, Covariance, Moments, Moment generating function, Chebychev's inequality, Bernoulli's Law of large numbers.

Unit –IV

Discrete Probability Distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric distribution. Continuous Probability Distributions: Uniform, Normal, Gamma, Beta, Exponential distribution (For All distributions only Mean, Variance, Moment Generating Function)

Text Book:
S.C Gupta and V.K Kapoor: Fundamentals of Mathematical Statistics
(Scope in Chapters 2-8).

Reference Book:
A.M. Mood , F.A. Graybill , D.C. Boes: Introduction to the Theory of Statistics

Bachelor of Science (Honours) Mathematics
Semester–III

Session- 2021-22
Course Title: Linear Algebra
Course Code: BOML-3334

Course Outcomes

After passing this course, the students will be able to:

CO1: To understand the concepts of base and dimension of vector space.

CO2: To get familiar with row and column space of a matrix.

CO3: To understand matrix representation of a linear transformation

CO4: To find kernel and image spaces of a linear transformation.

Bachelor of Science (Honours) Mathematics
Semester-III
Session 2021-22
Course Title: Linear Algebra
Course Code: BOML-3334

Examination Time: 3 Hours | Max. Marks: 100
Theory: 80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I
Definition and examples of vector spaces, properties of vector spaces, subspaces, examples ofsubspaces, sums and direct sums of subspaces, finite dimensional vector space: span of a listof vectors, linear independence and dependence of vectors.

Unit II
Basis of a vector space, extension of a list to a Linear Independent basis, reduction of aspanning list to a basis, direct complement of subspace, dimension theorems, quotient space,dimension of a quotient space.

Unit III
Linear maps, Null space, Range space, Rank-Nullity Theorem, Matrix of a linear map,invertibility of a linear map, algebra of linear maps.

Unit IV
Elementary matrix operations, elementary matrices, rank of a matrix, equality of row andcolumn rank, normal form for a matrix, invertible matrix as a product of elementary matrices,system of linear equations

Text Books:
1. Linear Algebra Done Rght by Sheldon Axler, Springer
2. Linear Algebra by Friedberg, S.H. Insel, A.J., Spence, L.E., PHI Learning Pvt. Ltd.
3. Linear Algebra by Vivek Sahai, Vikas Bist., Narosa Publishing House Pvt. Ltd.

Kanya MahaVidyalaya, Jalandhar(Autonomous)

Scheme and Curriculum of Examinations of Three-Year Degree Programme
Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22

Bachelor of Science (Honours) Mathematics Semester-IV							
Course Code	Course Type	Course Title	Max.Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-4331	C	Vector calculus	100	80	--	20	3
BOML-4332	C	Partial Differential Equations	100	80	--	20	3
BOML-4333	C	Group Theory	100	80	--	20	3
BOMM-4334	C	Statistical Methods	100	50	30	20	3+3
BOMM-4135	C	Foundation of Statistical Computing	100	50	30	20	3+3
SECS-4522	AC	*Social Outreach	25	20	-	5	No Exam
		Total Marks	500				

Note:

C Compulsory
AC Audit Course

*Marks of these papers will not be added in total marks and only grades will be provided.

Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22
Course Title : Vector Calculus
Course Code:BOML-4331
Course Outcomes

After passing this course, the students will be able to:

CO 1: Apply the concepts of line integral, double integral and triple integral in solving engineering problems.

CO 2: Understand the physical concept of vectors.

CO 3: Perform basic calculus on vector-valued functions.

CO 4: Solve physical problems based on calculus using vector-valued functions.

CO 5: Calculate the unit tangent vector, the unit normal vector and the unit binomial vector at a point on a space curve described by a vector-valued position function.

CO 6: Find the values of gradient, divergence and curl operator of given vectors.

CO 7: Find the application of Gauss theorem, Green's theorem and Stokes's theorem in real life problems.

Bachelor of Science (Honours) Mathematics
Semester–IV
Session 2021-22
Course Title: Vector Calculus
Course Code: BOML-4331

Examination Time: 3 Hours Max. Marks: 100

Theory: 80
CA: 20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit I

Scalar and vector product of three vectors, Product of four vectors, Reciprocal vectors, Vector differentiation, Scalar valued point functions, Vector valued point functions, Directional derivatives and the Gradient, Tangent plane and normal to a given surface.

Unit II

Gradient of a scalar point function, Divergence and Curl of a vector point function, Divergence and Curl of sums and products and their related vector identities, Laplacian operator.

Unit III

Orthogonal Curvilinear Coordinates, Conditions for orthogonality, Gradient, Divergence and Curl in terms of orthogonal curvilinear coordinates, Line integrals: Scalar and vector line integrals, line integrals along curves, Work done, Conservative vector fields, Green's theorem in plane.

Unit IV

Surface integral, Volume integral, Gauss Divergence Theorem, Stokes theorem and the problems based on these theorems.

Reference Books:

1. D. E. Bourne and P. C. Kendall, Vector analysis and Cartesian tensors, CRC Press, Taylor and Francis Group, London, Third edition, 1992 (Scope as in Chapters: 2-6)
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi, 42nd edition, 2012 (Scope as in Chapters: 3 (3.8-3.10) and 8)

Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22
Course Title: Partial Differential Equations
Course Code: BOML- 4332
Course Outcomes

After passing this course, the students will be able to:

CO 1: Apply a range of techniques to find solutions of partial differential equations.
CO 2: Understand basic properties of standard partial differential equations.
CO 3: Perform various methods to solve homogeneous and non-homogeneous partial differential equations and apply these methods in solving some physical problems.
CO 4: Formulate, classify and transform partial differential equations into canonical form.
CO 5: Determine the existence, uniqueness, and well-posedness of solution of PDEs
CO 6: Use computational tools to solve problems and applications of Partial Differential Equations.
CO 7: Apply in wide variety of disciplines Physics, Biology and Economics

Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22
Course Title: Partial Differential Equations
Course Code: BOML- 4332

Examination Time: 3 Hours Max. Marks: 100
Theory : 80
CA : 20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Partial Differential Equations of First Order: origin of first order partial differential equations. Formation of partial differential equations, Cauchy problem of first order equations,Linear P.D.E. of first order, Langrange's Method

Unit-II

Integral surface through a given curve, Surface orthogonal to given system of surfaces, Non linearP.D.E of first order, Charpit's method, Homogeneous linear P.D.E. with constant coefficients, method of finding the complementary function and particular integral.

Unit-III

Non homogeneous linear P.D.E. with constant coefficients, reducible and irreducible linear P.D.E. with constant coefficients, method of finding the complementary function and particular integral.

Unit-IV

Partial differential equations of the second order. Origin of 2nd order equations. Linear P.D.E. with constant coefficients and their complete solutions.Second order equation with variable coefficient and their classification and reduction to standard form.

Text Book:
1.MD Raisinghania: Ordinary and Partial Differential Equations, S Chand Publishing

Reference Books:
1. Piaggio: Differential equations.
2. Sneddon, I.N.: Elements of partial differential equations.

Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22
Course Title :Group Theory
Course Code:BOML - 4333
Course Outcomes

Upon completion of this course, students should be able to:

CO 1: Demonstrate understanding and the ability to work within various algebraic structures.
CO 2: Demonstrate understanding of the importance of algebraic properties with regard to working with various number systems.
CO 3: Effectively write abstract mathematical proofs in a clear and logical manner.
CO 4: Explain the fundamental concepts of groups and subgroups.
CO 5: Use Lagrange's theorem to analyze the cyclic subgroups of a group.
CO 6: Explain the significance of the notion of a normal subgroup, quotient group, cyclic group.
CO 7: State isomorphism theorems and use them to work with permutation, cyclic and normal groups.
CO 8: Describe the structure of finite abelian group.
CO 9: Use Cauchy's theorems to describe the structures of certain abelian groups.

Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22
Course Title: Group Theory
Course Code: BOML – 4333

Examination Time: 3 Hours Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Properties of Integers: Well ordering Principle, Division algorithm, Greatest common divisor, G.C.D. as a linear combination, Euclidean algorithm, Euclid's Lemma, Least common multiple, Fundamental Theorem of arithmetic, Integers modulo *n*, Binary relations, Equivalence relations, Equivalence classes partition.

Unit-II

Definition & examples of groups, Elementary properties of groups, Uniqueness of the identity element, Cancellation, Uniqueness of inverses, Subgroups, Examples of subgroups, Tests for a set to be a subgroup, Centralizer, Normalizer, Centre of a group.

Unit-III

Product of two subgroups, Properties of cosets, Lagrange's theorem,Normal subgroups, Factor groups, Cyclic groups, Properties of cyclic groups, Generators of cyclic groups, Fundamental theorem of cyclic groups.

Unit-IV

Permutation groups, Cyclic notation for permutations, Permutation as product of disjoint cycles, Order of a permutation, Commutativity of product of disjoint cycles, Permutation as a product of 2-cycles, Even and odd permutations, Alternating group.

Reference Books:

1. D. Burton, Elementary Number Theory, McGraw-Hill Education, New York, Seventh Edition, 2011 (Scope as in Chapters: 2, 3, 8).
2. J. A. Gallian, Contemporary Abstract Algebra, CRC Press, Taylor & Francis Group, New York, Ninth Edition, 2015 (Scope as in Chapters: 1-5, 7, 9).

Bachelor of Science (Honours) Mathematics Semester-IV
Session: 2021-22
Course Title:Statistical Methods
Course Code:BOMM-4334
Course Outcomes

Upon completion of this course, students should be able to:

CO 1: Understand the concept ofcorrelation among the data and its physical significances.

CO 2: State and apply the techniques to identify correlation between given set of data.

CO 3: Fit regression curves depicting relation among the physical quantities.

CO 4: Understand the logic and framework of the inference of hypothesis testing.

CO 5: Understand hypothesis testing as making an argument

CO 6: Interpret the results of the hypothesis test.

Bachelor of Science (Honours) Mathematics Semester-IV

Session: 2021-22
Course Title :Statistical Methods
Course Code:BOMM-4334

Examination Time: (3+3) Hours

Max. Marks: 100
Theory : 50
Practical : 30
CA : 20

Instructions for the Paper Setters:
Eight questions of equal marks (10 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be ttempted from any Section. The students can use only Non Programmable& Non Storage Type Calculator and statistical tables.
The question paper must contain 30% of the article/theory from the syllabus.

Unit-I

Bivariate data, Karl–Pearson's correlation coefficient and its Properties, Spearman's rank correlation coefficient, fitting of straight line, regression analysis.

Unit-II

Sampling Distributions: Chi-square, t and F-distributions with their mean and variance. Relation between Chi-square, t and F-distributions.

Unit-III

Large Sample test (Z Test): Test of single mean and difference of means, test for single proportion and difference of proportions, t test for single mean and equality of means.

Unit –IV

Chi-square test - as goodness of fit and association of attributes, F-test as test of equality of population of variance.

Note:
Practical: Based on syllabus of Statistical Methods for inferential Statistics.

Text Books:
1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics
2. Hogg R.V. ,Mckean, J.W. and Craig A.T.: Introduction to Mathematical Statistics

Kanya Maha Vidyalaya, Jalandhar (Autonomous)

Scheme and Curriculum of Examinations of Three Year Degree Programme
Bachelor of Science (Honours) Mathematics Semester-V
Session: 2021-22

Bachelor of Science (Honours) Mathematics Semester-V							
Course Code	Course Type	Course Title	Max. Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-5331	C	Number Theory	100	80	-	20	3
BOML-5332	C	Discrete Mathematics	100	80	-	20	3
BOML-5333	C	Linear Integral Equations	100	80	-	20	3
BOML-5334	C	Riemann Integration	100	80	-	20	3
BOML-5335	C	Metric Spaces	100	80	-	20	3
SECJ-5551	AC	*Job Readiness Course	25	20	-	5	1
Total Marks			500				

Note:
C -Compulsory
AC-Audit Course

*Marks of these papers will not be added in total marks and only grades will be provided.

Bachelor of Science (Honours) Mathematics
Semester–V
Session 2021 -22
Course Title: Number Theory
Course Code: BOML-5331

Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Find solutions of specified linear Diophantine equation.

CO 2: Solve system of linear congruences.

CO 3: Apply Fermat's and Euler's theorem to prove relation involving prime numbers.

CO 4: Apply the Wilson's theorem to solve numerical problems.

CO 5: Solve system of equations using congruences.

CO 6: Understand and apply properties functions in real world problems of phi.

CO 7: Understand application of important arithmetic functions.

Bachelor of Science (Honours) Mathematics
Semester–V
Session 2021 -22
Course Title: Number Theory
Course Code: BOML-5331

Examination Time: 3 Hours | Max. Marks: 100
Theory: 80
CA: 20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.
The question paper must contain 30% of the article/theory from the syllabus.

Unit-I

The Diophantine equation ax + by = c and its solution, Basic properties of congruences, Complete and Reduced set of residues modulo n, Special divisibility tests.

Unit-II

Polynomial conguences, Langrange's theorem, Linear congruences, Chinese remainder theorem, The Fermat's theorem, Pseudo prime, Absolutely Pseudo prime.

Unit-III

Wilson's theorem. Euler's Phi function, Euler's theorem, some properties of the Phi Function, Gauss theorem.

Unit-IV

Number-Theoretic functions: The Sum and Number of divisors, The Mobius Inversion formula, The Greatest integer function for treating divisibility problems.

Text Book:
D. Burton, Elementary Number Theory, McGraw-Hill Education, Boston, Seventh edition, 2012 (Scope as in Chapters 2, 4-7).

Bachelor of Science (Honours) Mathematics
Semester–V
Session 2021 -22
Course Title: Discrete Mathematics
Course Code: BOML-5332
Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Write an argument using logical notation and determine if the argument is or is not valid.

CO 2: Have substantial experience to comprehend formal logical arguments.

CO 3: Demonstrate the ability to write and evaluate a proof or outline the basic structure of and give examples of each proof technique described.

CO 4: Understand the language of graphs and trees.

CO 5: Understand the use of graphs as models.

CO 6: Understand various types of trees and methods for traversing trees.

Bachelor of Science (Honours) Mathematics
Semester–V
Session 2021 -22
Course Title: Discrete Mathematics
Course Code: BOML-5332

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit- I

Boolean Algebra – Boolean Algebra, Unary Operation, Binary Operation, Laws of Boolean Algebra, Principle of Duality, Boolean Function, Fundamental Product, Sum of Product form, Complete sum of Product form, Minterm, Disjunctive Normal form, Conjunctive Normal form, obtaining a Disjunctive Normal form, obtaining a Conjunctive Normal form, Karnaugh Map upto four variables, Applications of Boolean Algebra to Switching Circuits.

Unit- II

Graph, Subgraph, Paths, Directed and Undirected graphs, Connected graphs, Weakly connected graphs, Regular and bipartite graphs, Weighted graphs, Euler path and graphs, Hamiltonian path and graphs, planar graphs.

Unit- III

Chromatic number in graphs, shortest path in weighted graphs. Tree, directed tree, ordered tree, Binary tree, traversing binary tree, spanning tree, minimum spanning tree, Kruskal's algorithm to find minimum spanning tree.

Unit- IV

Propositional Calculus – Basic Logic Operations, Statement, Proposition, Propositional Variables, Truth Table, Combination of Propositions, Laws of the Algebra of Proposition, Variations in Conditional Statement, Principle of Duality, Logical Implication, Logical Equivalence of Proposition, Tautologies, Contradiction, Contingency, Argument, Proof of Validity, Quantifiers, Existential Quantifier, Universal Quantifier, Negation of Quantified Propositions, Propositions with Multiple Quantifier.

Text Book:
S. B. Gupta and C. P. Gandhi, Discrete Structures, University Science Press, Second edition, 2010 (Scope as in Chapters: 10, 11, 12, 13).

Bachelor of Science (Honours) Mathematics
Semester–V
Session 2021 -22
Course Title: Linear Integral Equations
Course Code: BOML-5333
Course Outcomes

On satisfying the requirements of this course, students will have the Knowledge of:
CO 1: Concept of Linear Integral equations and various kinds of Kernels.
CO 2: Volterra and Fredholm Integral equations of first and Second kind.
CO 3: Green's function and application of green's function in finding the solution of Boundary Value Problem and reduction of Boundary Value Problem to an Integral Equation.
CO 4: Techniques to solve homogeneous and non-homogeneous Fredholm and Volterra Integral equations.
CO 5: Laplace Transform and its basic properties.
CO 6: Application of Laplace Transform in finding solution of Abel's equation and Volterra Integral Equation.

Bachelor of Science (Honours) Mathematics
Semester–V
Session 2021 -22
Course Title: Linear Integral Equations
Course Code: BOML-5333

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Linear integral equations of the first and second kind of Fredholm and Volterra type, some basic identities, Types of kernels: Symmetric kernel, Separable kernel, Iterated kernel, resolvent kernel, Initial value problems reduced to Volterra integral equations, Solution of Volterra integral equation using: Resolvent kernel, Successive approximation.

Unit-II

Boundary value problems reduced to Fredholm integral equations, Solution of Fredholm integral equations using separable kernel, resolvent kernel. Methods of successive approximation to solve Fredholm equations of second kind. Solution of Homogeneous Fredholm integral equation: Eigen values, eigen vectors.

Unit-III

Integral transforms for solving integral equations: Basic properties of Laplace transforms, Solution of Abel's equation using Laplace transform, Application of Laplace transform to the Solution of Volterra integral equations with convolution type kernels.

Unit-IV

Green's function, Basic four properties of the Green's function, Procedure for construction of the Green's function by using its basic four properties, Construction of Green's function for boundary value problems, Solution of boundary value problems using Green's function, reducing boundary value problems to an integral equation using Green's function.

Text Book:

M.D. Raisinghania, Integral Equations & Boundary Value Problems, S. Chand Co. Pvt. Ltd., New Delhi, First Edition, 2007 (Scope as in Chapters 1-6,9,11).

Bachelor of Science (Honours) Mathematics
Semester–V
Session: 2021-22
Course Title: Riemann Integration
Course Code: BOML-5334
Course outcomes

After passing this course, the students will be able to:

CO 1: To understand the concepts of Riemann sum, partitions, upper and lower sums, Riemann integrability of continuous functions and of monotone functions.
CO 2: To know and describe the converging behavior of improper integrals and Beta, Gamma functions.
CO 3: To distinguish between the absolute convergence and conditional convergence.
CO 4: To find the relation between Beta and Gamma functions.
CO 5: Understand and apply properties of Beta and Gamma functions in real world problems.

Bachelor of Science (Honours) Mathematics
Semester–V
Session: 2021-22
Course Title: Riemann Integration
Course Code: BOML-5334

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Definition and Existence of the Riemann Integral, Partitions and Riemann (or Darboux) sums, Some properties of Darboux Sums, Upper and lower Riemann integrals, Refinement of partitions, Darboux's Theorem, Necessary and sufficient conditions for integrability.

Unit-II

Particular classes of Integrable functions, Properties of integrable functions, Integrability of the sum, difference, product, quotient and modulus, The Fundamental theorem of integral calculus, First and Second mean value theorems of integral calculus.

Unit-III

Improper Integrals and conditions for existence, Comparison test for convergence of improper integrals, Abel's Test and Dirichlet test for convergence.

Unit-IV

Absolute convergence and conditional convergence of improper integrals, Beta and Gamma functions, Properties of Beta functions, Recurrence formulae for Gamma function, Relation between Beta and Gamma functions.

Text Book:
S. Narayan and M. D. Raisinghania, Elements of Real Analysis, S. Chand & Co. Pvt. Ltd., New Delhi, Seventeenth Edition, 2016 (Scope as in chapters: 13, 16, 20).

Reference Books:
1. A. Kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, Taylor & Francis Group, New York, First Edition, 2014 (Scope as in chapters: 6).
2. S. C. Malik and S. Arora, Mathematics Analysis, New Age International Publishers, New Delhi, Second Edition, 2005 (Scope as in chapters: 9,11).

Bachelor of Science (Honours) Mathematics
Semester–V
Session: 2021-22
Course Title: Metric Spaces
Course Code: BOML-5335
Course outcomes

After passing this course, the students will be able to:

CO 1: Explain the fundamental concepts of Metric Spaces and their role in modern mathematics.
CO 2: Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts of Metric Spaces.
CO 3: Give argument related to convergence, continuity, completeness, compactness, connectedness in metric spaces.
CO 4: Understand and derive proofs of mathematical theorems. This includes understanding the role of axiom, logic and particular proof techniques such as proof by induction, proof by contradiction etc.

Bachelor of Science (Honours) Mathematics
Semester–V
Session: 2021-22
Course Title: Metric Spaces
Course Code: BOML-5335

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Metric on a set, Metric space,definitionsandexamples,opensets,interior and closure ofaset,closedset,denseand nowheredensesets,exterior,frontierandboundarypointsandtheir properties.

Unit-II

Compact subsets ofametricspace,elementarypropertiesofcompactsets,Heine-Boreltheorem, separatedsets,connected subsetsof a metric space.

Unit-III

Sequencesinametricspace, Convergent Sequences, CauchySequences, CompleteMetric Spaces,Cantor'sIntersectionTheorem,Baire'sCategoryTheorem.

Unit-IV

ContinuousFunctionsinametricspace,continuityandcompactness,continuityand connectedness,discontinuities,monotonicfunctions,uniformcontinuity.

Text Book:
S. NarayanandM. D.Raisinghania, ElementsofRealAnalysis,S.Chand& Company, New Delhi, 12th Edition, 2011 (Scope as in Chapter- 19)

Reference Books:
1.S. C.MalikandS. Arora, MathematicsAnalysis, New Age International Publishers, New Delhi, 5th Edition, 2021 (Scope as in Chapter- 19)
2.W. Rudin, Principles of Mathematical Analysis, McGraw-Hill Education, New York, 3rd Edition, 1976 (Scope as in Chapters- 2, 3(3.1-3.12), 4)

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Scheme and Curriculum of Examinations of ThreeYear Degree Programme
Bachelor of Science (Honours) Mathematics Semester-VI
Session: 2021-22

Bachelor of Science (Honours) Mathematics Semester-VI							
Course Code	Course Type	Course Title	Max. Marks				Examination time in hours
			Total	Ext.		CA	
				L	P		
BOML-6331	C	Complex Analysis	100	80	-	20	3
BOML-6332	C	Analytical Skills	100	80	-	20	3
BOML-6333	C	Numerical Analysis	100	80	-	20	3
BOML-6334	C	Special Functions	100	80	-	20	3
BOML-6335	C	Differential Geometry	100	80	-	20	3
Total Marks			500				

Note:
C -Compulsory

Bachelor of Science (Honours) Mathematics

Semester–VI

Session: 2021-22

Course Title: Complex Analysis

Course Code: BOML-6331

Course outcomes

After passing this course, the students will be able to:

CO1: Justify the need for a complex number system and explain how it is related to other existing number system.

CO2: Define a function of complex variable and carry out basic mathematical operations with complex numbers.

CO3: State and prove the Cauchy Riemann Equation and use it to show that a function is analytic.

CO4: Define singularities of a function, know the different types of singularities and be able to determine the points of singularities of a function.

Bachelor of Science (Honours) Mathematics
Semester–VI
Session: 2021-22
Course Title: Complex Analysis
Course Code: BOML-6331

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Functions of complex variables, Topology of real line and complex plane, limit, continuity and differentiability, Analytic functions, Conjugate function, Cauchy Riemann equations (Cartesian form), Harmonic function, Construction of analytic functions.

Unit-II

Complex line integral, Cauchy's theorem, Cauchy's integral formula and its generalized form, Cauchy's inequality, Poisson's integral formula, Morera's theorem, Liouville's theorem.

Unit-III

Taylor's theorem, Laurent's theorem, Zeros and Singularities of an analytic function, Residue at a pole and at infinity, Cauchy's Residue theorem.

Unit-IV

The Fundamental Theorem of Algebra, The Argument principle, Rouche's theorem, Conformal transformations, Bilinear transformations, Critical points, Fixed points, The cross ratio, Problems on cross ratio and bilinear transformation.

Text Book:

S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, Second Edition, 1995 (Scope as in Chapters: 1-5).

Reference Books:

1. S. Narayan, Theory of Functions of a Complex Variable, S. Chand Co. Pvt. Ltd., New Delhi, Fourth Edition, 2009 (Scope as in Chapters: 3, 5, 7, 9, 11).
2. J. W. Brown and R. V. Churchill, Complex Variables and Applications, McGraw-Hill Education, New York, Eighth Edition, 2004 (Scope as in Chapters: 1, 2, 4, 5, 6, 7, 9).

Bachelor of Science (Honours) Mathematics
Semester–VI
Session: 2021-22
Course Title: Analytical Skills
Course Code: BOML-6332
Course outcomes

After passing this course, the students will be able to:

CO 1: Analyze data being presented in the form of tables, venn diagrams, pie charts.

CO 2: Demonstrate procedural fluency with real number arithmetic operations and use these operations to represent real world scenarios and to solve stated problems.

CO 3: Demonstrate number sense and conversion between fractions, decimals and percentages.

CO 4: Draw conclusions or make decisions in quantitatively based situations that are dependent upon multiple factors.

CO 5: Use simple and compound interest to do business calculations such as value of money, maturity value, present value, future value and able to differentiate which math method should be used for different problems.

Bachelor of Science (Honours) Mathematics
Semester–VI
Session: 2021-22
Course Title: Analytical Skills
Course Code: BOML- 6332

Examination Time: 3 Hours Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Sequence and Series: Analogies of Numbers and Alphabets, Completion of blank spaces following the pattern in A: b::C: d relationship, Odd thing out, Missing number in a sequence or a series.

Date, Time and Arrangement Problems: Calendar Problems, Clock Problems, Blood Relationship.

Unit -II

Arithmetic Ability: Algebraic operations BODMAS, Fractions, Decimals Fractions, Divisibility rules, LCM & GCD (HCF), Elementary Algebra.

Quantitative Aptitude: Averages, Ratio and proportion, Problems on ages, Time and Work, Work and Wages, Pipes and Cisterns, Time and Distance, Trains, Streams.

Unit -III

Mensuration: Measurement of Areas, Surface Areas and Volume.

Business Computations: Percentages, Profit & Loss, Partnership, Simple and Compound Interest.

Unit-IV

Data Analysis: The data given in a Table, Graph, Bar Diagram, Pie Chart, Venn diagram or a Passage is to be analyzed and the questions pertaining to the data are to be answered.

Reference Books:

1. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Co. Pvt. Ltd., New Delhi, Eighth Edition, 2017 (Scope as in Chapters:1-4, 6, 8, 11-14, 16-20, 22-25, 27-28, 35 (Section I) and Chapters 36-39 (Section II)).
2. R.V. Praveen, Quantitative Aptitude and Reasoning, PHI Learning Pvt. Ltd., Delhi, Third Edition, 2016 (Scope as in Chapters: 1, 4-8, 13-21, 23-29, 32, 34, 36, 39 (Part I) and Chapters 1,3,5 (Part II)).

Bachelor of Science (Honours) Mathematics
Semester–VI
Session 2021 -22
Course Title: Numerical Analysis
Course Code: BOML-6333
Course Outcomes

After passing this course, the students will be able to:

CO 1. Perform computation for solving a system of equations.

CO 2. Understand its application in all branches of engineering.

CO 3. Know how to find the roots of transcendental equations.

CO 4. Learn how to interpolate the given set of values.

CO 5. Understand the curve fitting for various polynomials.

CO 6. Learn numerical solution of differential equations.

CO 7. Compute numerical integration and differentiation, numerical solution of ordinary differential equations.

Bachelor of Science (Honours) Mathematics
Semester–VI
Session 2021 -22
Course Title: Numerical Analysis
Course Code: BOML-6333

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setter:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.
The students can use only Non-Programmable& Non-Storage Type Calculator.

Unit-I

Error generation, error propagation, error estimation and error bounds, Solution of non-linear equations, Bisection method, Method of false position, Newton-Raphson method, Generalized Newton-Raphson method, Iteration method, Muller's method, Rate of convergence of these methods.

Unit-II

Solution of linear system of equation: Direct method, Gauss elimination variant (Gauss Jordan and Crout reduction), Triangular Method, Iterative methods: Jacobi's method, Gauss Seidel method. Finite Differences: Forward, Backward, Central, Divided differences, shift operator, relationship between the operators and detection of errors by use of difference operator. Interpolation with divided difference, Newton's formula, Lagrangian method.

Unit-III

Finite difference interpolation, Gauss formula, Stirling formula, Bessel's formula, Error Estimation, Extrapolation. Numerical differentiation: Method based on interpolation. Numerical Integration: Trapezoidal rule, Simpson's rule, Weddle rule, Romberg integration, Gaussian integration method, Gaussian legendre integration. Double numerical integration.

Unit-IV

Numerical solution of ordinary differential equations, Initial value problem, Taylor's method, Euler's methods, Picard's method, Milne's method, Runge-Kutta method, Predictor-Corrector's method.

Text Book:

M. K. Jain, S. R. K. Iyengar and R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, Delhi, Fifth edition, 2007 (Scope as in Chapters 2-6).

Bachelor of Science (Honours) Mathematics
Semester–VI
Session: 2021 -22
Course Title: Special Functions
Course Code: BOML-6334
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the Hypergeometric function.

CO 2: Understand the special differential equations Bessel, Legendre, Hermite.

CO 3: Understand the Bessel function and its relation with Hypergeometric function .

CO 4: Understand the Legendre function and its Hypergeometric forms.

CO 5: Understand the Hermite Polynomials and its relation as ${}_2F_0$.

Bachelor of Science (Honours) Mathematics
Semester–VI
Session :2021 -22
Course Title: Special Functions
Course Code: BOML-6334

Examination Time: 3 Hours Max. Marks: 100

Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Hypergeometric functions, The function $F(a,b,c,z)$, Integral form, Evaluation of $F(a,b,c,1)$, The contiguous function relations, The Hypergeometric differential equation, solution of hypergeometric equation, $F(a,b,c,z)$ as a function of its parameters, Relation between z and 1-z, A quadratic transformation, A theorem due to Kummer.

Unit -II

Bessel's functions of first and second kind, Bessel's differential equation, Recurrence relations, Generating functions, Bessel's integral, Modified Bessel functions, Neumann polynomials, Neumann series.

Unit –III

Legendre's function $P_n(x)$, A generating function, Recurrence relation, Legendre differential equation, The Rodrigues formula, Bateman's generating function, Hypergeometric forms of $P_n(x)$ Laplace's first integral form, Orthogonality.

Unit -IV

Hermite Polynomials, Recurrence relations, Rodrigues formula, Integrals, The Hermite polynomial as $2^{F}{}_{0}$, Orthogonality.

Text Book:
1. S. S Trivedi, Special functions, Pragati Prakashan, Meerut, XXI edition, 2021 (Scope as in chapters 3,4,5,6,7)
Reference Book:

1. M.D. Raisinghania, Ordinary and Partial Differential equations, S. Chand publication, New Delhi , 18th edition, 2013 (Scope as in chapters 9,10,11,12,14)

Bachelor of Science (Honours) Mathematics
Semester–VI
Session 2021 -22
Course Title: Differential Geometry
Course Code: BOML-6335
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand tensor variables, metric tensor, contra-variant, covariant and mixed tensors & and able to apply tensors among mathematical tools for invariance.

CO 2: Understand the reason why the tensor analysis is used and explain usefulness of the tensor analysis.

CO 3: Able to explain the concept of theory of space curve tangent, normal, binormal and Serret-Frenet Formulae.

CO 4: Able to understand contact between curves and surfaces, locus of centre of curvature, spherical curvature as well as to calculate the curvature and torsion of a curve.

CO 5: Understand the concept of Spherical indicatrix, envelopes, two fundamental forms, lines of curvature, principal curvature and to calculate the first and second fundamental forms of a surface.

Bachelor of Science (Honours) Mathematics
Semester–VI
Session 2021 -22
Course Title: Differential Geometry
Course Code: BOML-6335

Examination Time: 3 Hours | Max. Marks: 100
Theory:80
CA:20

Instructions for the Paper Setters:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Curves in R^3: A simple arc, curves and their parametric representation, arc length, contact of curves, tangent line, osculating plane, principal normal, binormal, normal plane, rectifying plane.

Unit-II

Curvature and torsion, Serret-Frenet Formulae, Helics, Evolute and Involute of a parametric curve, Osculating circle and osculating sphere, spherical curves.

Unit –III

Surfaces in R^3: Implicit and Explicit forms of the equation of surface, two fundamental forms of a surface, Family of surfaces, Edge of regression, Envelops .

Unit -IV

Einstein's summation convention, Transformations of coordinates, Tensor's law for transformation, contravariant, covariant and mixed Tensors, addition, outer product, contraction, inner product and quotient law of tensors, metric Tensor and Riemannian metric.

Text Book:
1. G.S Malik, Differential Geometry, Pragati Prakashan, Meerut , IX edition , 2013 (Scope as in chapters 1-10)

Reference Books:
1. D Somasundaram, Differential Geometry: A first Course, Alpha Science International Limited, New Delhi, 2005 (Scope as in chapters 1,2)
2. C.E Weather burn, Differential Geometry, Cambridge University Press, Cambridge (Scope as in chapters 1,2,3,4)