UG PROGRAM (4 Years Honors)
CBCS-2020-21

B.A / B.Sc
MATHEMATICS

Syllab s and Model Question Papers

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1. Resolutions of the Board of Studies

Meeting held on:…22-1-2021…........ Time:10 am At: Convention centre,
Adikavi Nannayya university,Rajahmundry

Agenda: Finalising the revised syllabus of UG Mathematics under CBCS frame work with effect from2020-021.

Members present:
1. Dr.D.Chitti Babu, Convenor
2. Dr.D.Ch. Papa Rao, Member
3. Sri G.Sridhar, Member
4. Dr.K.Revathi, Coordinator

Resolutions:
After reviewing the existing titles and contents of classes I,II,III and IV framed by APSCHE, The boardcome out with the following resolutions.

Resolution-1
It is resolved to approve the following changes of courses I,II,III and IV of mathematics as it is given byAPSCHE.

COURSE I:
1. Change of variables topic is deleted in Unit-I.
2. Orthogonal trajectories and equations that do not contain x or y topics are deleted in Unit-II.
3. Linear differential equations with non-constant coefficients is restricted to one Method only i.e. whenpart of C.F. is known.

COURSE II:
1. Simplified form of the equations of two spheres topic is deleted in Unit-IV
2. Limiting points topic is added in Unit IV.

COURSE III:
1. Homomorphism topic is shifted from Unit-III Unit-IV.
2. Cyclic groups topic is deleted in Unit-IV
3. Ideals topic is deleted in Unit-IV

COURSE IV:
1. Bolzano-Weierstrass theorem topic is deleted in Unit-I
2. Absolute convergence and conditional convergence topics are deleted in Unit-II
3. Uniform continuity topic is deleted in Unit-III.
4. Integral as the limit of a sum and mean value theorems topic is changed to first mean value theoremin Unit-V.

COURSE V:
1. Matrices, elementary properties, Inverse matrix, Rank of a matrix are deleted in Unit-IV

Resolution 2.
It is resolved to approve the necessary changes in Blue print and model Courses of Courses I, II, III and
IV. The Course setters should strictly follow the prescribed book and model Courses

UG Program (4 years Honors) Structure (CBCS)
2020-21 A. Y., onwards
BACHLOR OF SCIENCE
(3^{rd} and 4^{th} year detailed design will be followed as per APSCHE GUIDELINES)

Subjects/ Semesters		I		II		III		IV		V		VI			
		H/W	C	H/W	C	H/W	C	H/W	C	H/W	C	H/W	C		
Languages												THIRD PHASE of APPRENTICESHIP Entire 5th / 6th Semester		FIRST and SECOND PHASES (2 spells) of APPRENTICESHIP between 1st and 2nd year and between 2nd and 3rd year (two summer vacations).	
English		4	3	4	3	4	3								
Language (H/T/S)		4	3	4	3	4	3								
Life Skill Courses		2	2	2	2	2+2	2+2								
Skill Development Courses		2	2	2+2	2+2	2	2								
Core Papers															
M-1	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2 4+2	4+1 4+1						
M-2	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2 4+2	4+1 4+1						
M-3	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2 4+2	4+1 4+1						
M-1	SEC (C6,C7)									4+2 4+2	4+1 4+1				
M-2	SEC (C6,C7)									4+2 4+2	4+1 4+1				
M-3	SEC (C6,C7)									4+2 4+2	4+1 4+1				
Hrs/ W (Academic Credits)		30	25	32	27	32	27	36	30	36	30	0	12	4	4
Project Work															
Extension Activities (Non Academic Credits)															
NCC/NSS/Sports/Extra Curricular									2						
Yoga							1		1						
Extra Credits															
Hrs/W (Total Credits)		30	25	32	27	32	28	36	33	36	30	0	12	4	4

M= Major; C= Core; SEC: Skill Enhancement Courses

2. DETAILS OF COURSE TITLES & CREDITS

Marks & Credits distribution: UG-Sciences

Sl. No	Course type	No. of courses	Each course teaching Hrs/wk	Credit for each course	Total credits	Each course evaluation			Total marks
						Conti-Assess	Univ-exam	Total	
1	English	3	4	3	9	25	75	100	300
2	S.Lang	3	4	3	9	25	75	100	300
3	LS	4	2	2	8	0	50	50	200
4	SD	4	2	2	8	0	50	50	200
5	Core/SE -I	5+2	4+2	4+1	35	25	75+50	150	1050
	Core/SE -II	5+2	4+2	4+1	35	25	75+50	150	1050
	Core/SE -III	5+2	4+2	4+1	35	25	75+50	150	1050
6	Summer-Intern	2		4	8		100	200	200
7	Internship/ Apprentice/ on the job training	1		12	12		200	2200 5	200
		38			**159**				**4550**
8	**Extension Activities (Non Academic Credits)**							2 5	
	NCC/NSS/Sports/ Extra Curricular			2	2				
	Yoga	2		1	2				
	Extra Credits							2	
	Total	**40**			**142**			5	

Sem	Course No	Course Name	Course Type (T/L/P)	Hrs/Week (Arts/ Commerce &Science	Credits (Arts/Commerce &Science	Max. Marks Count/ Internal/Mid Assessment	Max. Marks (Sem-End)
I	1	Differential Equations	T	5	4	25	75
II	2	Three Dimensional Analytical Solid Geometry	T	5	4	25	75
III	3	Abstract Algebra	T	5	4	25	75
IV	4	Mathematics Real Analysis	T	5	4	25	75
	5	Linear Algebra	T	5	4	25	75
V	6A	Numerical Methods	T	5	4	25	75
	7A	Mathematical Special Functions	T	5	4	25	75
	OR						
	6B	Multiple integrals and Applications of Vector Calculus	T	5	4	25	75
	7B	Integral transforms with Applications	T	5	4	25	75
	OR						
	6C	Partial Differential Equations and Fourier Series	T	5	4	25	75
	7C	Number theory	T	5	4	25	75

Note: *Course type code: T: Theory, L: Lab, P: Problem solving

Note 1: For Semester–V, for the domain subject **MATHEMATICS**, any one of the three pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A & 7A or 6B & 7B or 6C & 7C. The pair shall not be broken (ABC allotment is random, not on any priority basis).

Note 2: One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate field skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the field skills embedded in the syllabus citing related real field situations.

Note 3: To insert assessment methodology for Internship/ on the Job Training/Apprenticeship under the revised CBCS as per APSCHE Guidelines.

- **First internship (After 1st Year Examinations):** Community Service Project. To inculcate social responsibility and compassionate commitment among the students, the summer vacation in the intervening 1st and 2nd years of study shall be for Community Service Project (the detailed guidelines are enclosed).
- **Credit For Course: 04**

- **Second Internship (After 2nd Year Examinations):** Apprenticeship / Internship / on the job training / In-house Project / Off-site Project. To make the students employable, this shall be undertaken by the students in the intervening summer vacation between the 2nd and 3rd years (the detailed guidelines are enclosed).
- **Credit For Course: 04**

- **Third internship/Project work (6th Semester Period):**
During the entire 6th Semester, the student shall undergo Apprenticeship / Internship / On

the Job Training. This is to ensure that the students develop hands on technical skills which will be of great help in facing the world of work (the detailed guidelines are enclosed).

- **Credit For Course:12**

a. proposed combination subjects: NIL
b. Student eligibility for joining in the course: NIL
c. Faculty eligibility for teaching the course NIL
d. List of Proposed Skill enhancement courses with syllabus, if any NIL
e. Any newly proposed Skill development/Life skill courses with draft syllabus and requiredresources NIL

f. Required instruments/software/ computers for the course (Lab/Practical course-wise required i.e., fora batch of 15 students)

Sem. No.	Lab/Practical Name	Names of Instruments/Software/ computers required with specifications	Brand Name	Qty Required
1	Lab Name:	-	-	-
2	Lab Name:	--	-	-

g. List of Suitable levels of positions eligible in the Govt/Pvt organizations

Suitable levels of positions for these graduates either in industry/govt organization like., technical assistants/ scientists/ school teachers., clearly define them, with reliable justification

S.No	Position	Company/ Govt organization	Remarks	Additional skills required, if any
-	-	-	-	-
-	-	-	-	-

h. List of Govt. organizations / Pvt companies for employment opportunities or internships or projects

S.No	Company/ Govt organization	Position type	Level of Position			
-	-	-	-	-	-	-
-	-	-	-	-	-	-

i. Any specific instructions to the teacher /Course setters/Exam-Chief Superintendent NIL.

3. Program objectives, outcomes, co-curricular and assessment methods

BSc/BA	MATHEMATICS

1. Aim and objectives of UG program in Subject: MATHEMATICS In this course UG program, student will learn the higher mathematics topics to enable to learn and solve problems in different fields.

2. Learning outcomes of Subject (in consonance with the Bloom's Taxonomy):

After successful completion of the course, the student will be able to

1. Solving linear differential equations.
2. Understand the concept and apply appropriate methods for solving differential equations.
3. Recommended Skill enhancement courses: (Titles of the courses given below and details of the syllabus for 4 credits (i.e., 2 units for theory and Lab/Practical) for 5 hrs class-cum-lab work NIL
4. Recommended Co-curricular activities:(Co-curricular Activities should not promote copying from text book or from others' work and shall encourage self/independent and group learning)

A. Measurable:

1. Assignments on: different topics of the subject.
2. Student seminars (Individual presentation of Courses) on topics relating to:Mathematics subject.
3. Quiz Programmes on: different units of the course .
4. Individual Field Studies/projects: study projects in different fields
5. Group discussion on: nil
6. Group/Team Projects on: nil

B. General

1. Collection of news reports and maintaining a record of Course-cuttings relating to topics covered in syllabus. Yes
2. Group Discussions on: different areas of the subject
3. Watching TV discussions and preparing summary points recording personal observations etc., under guidance from the Lecturers Yes
4. Any similar activities with imaginative thinking. Nil
5. Recommended Continuous Assessment methods:

   Thorough Assignments and seminars on different areas of the course and problem solving sessions in various unit of the course.

4. Details of course-wise Syllabus

DETAILS OF COURSE-WISE SYLLABUS

B.A/ B.Sc	Semester-I	Credits:4
Course:1	DIFFERENTIAL EQUATIONS	Hrs/Weak:5

Course Outcomes:
After successful completion of this course, the student will be able to;

- Solve linear differential equations
- Convert non exact homogeneous equations to exact differential equations by using integrating factors
- Know the methods of finding solutions of differential equations of the first order but not of the first Degree.
- Solve higher-order linear differential equations, both homogeneous and non homogeneous, with constant coefficients.
- Understand the concept and apply appropriate methods for solving differential equations.

UNIT I: (12 Hours)

Differential Equations of first order and first degree:
Linear Differential Equations; Differential equations reducible to linear form; Exact differential equations; Integrating factors.

UNIT II: (12 Hours)

Differential Equations of first order but not of the first degree:
Equations solvable for p; Equations solvable for y; Equations solvable for x; Equations homogeneous in x and y; Equations of the first degree in x and y – Clairaut's Equation.

UNIT III: (12 Hours)

Higher order linear differential equations-I:
Solution of homogeneous linear differential equations of order n with constant coefficients; Solution of the non-homogeneous linear differential equations with constant coefficients by means of polynomial operators. General Solution of f(D)y=0.
General Solution of f(D)y=Q when Q is a function 1/f(D) is expressed as partial fractions of x,
P.I. of f(D)y = Q when Q= be^{ax}
P.I. of f(D)y = Q when Q is bsin ax or b cos ax.

UNIT IV: (12 Hours)

Higher order linear differential equations-II:
Solution of the non-homogeneous linear differential equations with constant coefficients.
P.I. of f(D)y = Q when Q= bx^k
P.I. of f(D)y = Q when Q= e^{ax} V **,** where V is a function of x.
P.I. of f(D)y = Q when Q= xV **,** where V is a function of x.
of f(D)y = Q when Q= x^mV **,** where V is a function of x.

UNIT V: (12 Hours)

Higher order linear differential equations-III :
Method of variation of parameters; Linear differential Equations with non-constant coefficients(Solution when a part of CF is known method only); The Cauchy-Euler Equation, Legendre's linear equations.

Co-Curricular Activities(15 Hours)
Seminar/ Quiz/ Assignments/ Applications of Differential Equations to Real life Problem /Problem Solving.

TEXT BOOK :

1. Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Pvt. Ltd, New Delhi-Second edition.

REFERENCE BOOKS :

1. A text book of Mathematics for B.A/B.Sc, Vol 1, by N. Krishna Murthy & others, published by S.Chand & Company, New Delhi.
2. Ordinary and Partial Differential Equations by Dr. M.D,Raisinghania, published by S. Chand & Company, New Delhi.
3. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha Universities Press.
4. Differential Equations -Srinivas Vangala & Madhu Rajesh, published by Spectrum University Press.

B.A/ B.Sc	Semester-II	Credits:4
Course:2	THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY	Hrs/Weak:5

Course Outcomes:

After successful completion of this course, the student will be able to;

1. get the knowledge of planes.
2. basic idea of lines, sphere and cones.
3. understand the properties of planes, lines, spheres and cones.
4. express the problems geometrically and then to get the solution.

UNIT I: (12hrrs)

The Plane: Equation of plane in terms of its intercepts on the axis, Equations of the plane through the given points, Length of the perpendicular from a given point to a given plane, Bisectors of angles between two planes, Combined equation of two planes, Orthogonal projection on a plane.

UNIT II: (12 hrs)

The Line :Equation of a line; Angle between a line and a plane; The condition that a given line may lie in a given plane; The condition that two given lines are coplanar; Number of arbitrary constants in the equations of straight line; Sets of conditions which determine a line; The shortest distance between two lines; The length and equations of the line of shortest distance between two straight lines; Length of the perpendicular from a given point to a given line.

UNIT III: (12 hrs)

The Sphere :Definition and equation of the sphere; Equation of the sphere through four given points; Plane sections of a sphere; Intersection of two spheres; Equation of a circle; Sphere through a given circle;
Intersection of a sphere and a line; Power of a point; Tangent plane; Plane of contact; Polar plane; Pole of a Plane; Conjugate points; Conjugate planes;

UNIT IV: (12 hrs)

The Sphere and Cones : Angle of intersection of two spheres; Conditions for two spheres to be orthogonal; Radical plane; Coaxial system of spheres. Limiting Points.
Definitions of a cone; vertex; guiding curve; generators; Equation of the cone with a given vertex and guiding curve; equations of cones with vertex at origin are homogenous; Condition that the general equation of the second degree should represent a cone;

UNIT V: (12 hrs)

Cones :Enveloping cone of a sphere; right circular cone: equation of the right circular cone with a given vertex, axis and semi vertical angle: Condition that a cone may have three mutually perpendicular generators; intersection of a line and a quadric cone; Tangent lines and tangent plane at a point; Condition that a plane may touch a cone; Reciprocal cones; Intersection of two cones with a common vertex.

Co-Curricular Activities 15 Hours)

Seminar/ Quiz/ Assignments/Three dimensional analytical Solid geometry and its applications/ Problem Solving.

TEXT BOOK :

1. Analytical Solid Geometry by Shanti Narayan and P.K. Mittal, published by S. Chand & Company Ltd. 7th Edition.

REFERENCE BOOKS :

1. A text book of Mathematics for BA/B.Sc Vol 1, by V Krishna Murthy & Others, published by S. Chand & Company, New Delhi.
2. A text Book of Analytical Geometry of Three Dimensions, by P.K. Jain and Khaleel Ahmed, published by Wiley Eastern Ltd., 1999.
3. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K.Y. Subrahmanyam, G.R. Venkataraman published by Tata-MC Gran-Hill Publishers Company Ltd., New Delhi.
4. Solid Geometry by B.Rama Bhupal Reddy, published by Spectrum University Press.

B.A/ B.Sc	Semester-III	Credits:4
Course:3	ABSTRACT ALGEBRA	Hrs/Weak:5

Course Outcomes:
After successful completion of this course, the student will be able to;

- acquire the basic knowledge and structure of groups, subgroups and cyclic groups.
- get the significance of the notation of a normal subgroups.
- get the behavior of permutations and operations on them.
- study the homomorphisms and isomorphisms with applications.
- Understand the ring theory concepts with the help of knowledge in group theory and to prove the theorems.
- Understand the applications of ring theory in various fields.

UNIT I: **(12 Hours)**
GROUPS : Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

UNIT II: **(12 Hours)**
SUBGROUP: Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition- examples-criterion for a complex to be a subgroups. Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. **Co-sets and Lagrange's Theorem:** Cosets Definition – properties of Cosets–Index of a subgroups of a finite groups–Lagrange's Theorem.

UNIT III: **(12 Hours)**
NORMAL SUBGROUPS: Definition of normal subgroup – proper and improper normal subgroup–Hamilton group – criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups – Sub group of index 2 is a normal sub group –quotient group – criteria for the existence of a quotient group.

UNIT IV: **(12 Hours)**
HOMOMORPHISM : Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

PERMUTATIONS: Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

UNIT V: **(12 Hours)**
RINGSDefinition of Ring and basic properties, Boolean Rings, divisors of zero and cancellation laws Rings, Integral Domains, Division Ring and Fields, The characteristic of a ring - The characteristic of an Integral Domain, The characteristic of a Field. Sub Rings.

Co-Curricular Activities(15 Hours)
Seminar/ Quiz/ Assignments/ Group theory and its applications / Problem Solving.

TEXT BOOK :
1. A text book of Mathematics for B.A. / B.Sc. by B.V.S.S. SARMA and others, published by S.Chand & Company, New Delhi.

REFERENCE BOOKS :
1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna.
3. Rings and Linear Algebra by Pundir & Pundir, published by Pragathi Prakashan.

B.A/ B.Sc	Semester-IV	Credits:4
Course:4	MATHEMATICS REAL ANALYSIS	Hrs/Weak:5

Course Outcomes:
After successful completion of this course, the student will be able to

- get clear idea about the real numbers and real valued functions.
- obtain the skills of analyzing the concepts and applying appropriate methods for testing convergence of a sequence/ series.
- Test the continuity and differentiability and Riemann integration of a function.
- Know the geometrical interpretation of mean value theorems.

UNIT I: **(12 Hours)**
Introduction of Real Numbers (No question is to be set from this portion)
Real Sequences: Sequences and their limits, Range and Boundedness of Sequences, Limit of a sequence and Convergent sequence. The Cauchy's criterion, properly divergent sequences, Monotone sequences, Necessary and Sufficient condition for Convergence of Monotone Sequence, Limit Point of Sequence, Subsequences , Cauchy Sequences – Cauchy's general principle of convergence theorem.

UNIT II: **(12 Hours)**
INFINITIE SERIES :
Series : Introduction to series, convergence of series. Cauchy's general principle of convergence for series tests for convergence of series, Series of Non-Negative Terms.
1. P-test
2. Cauchy's n^{th} root test or Root Test.
3. D'-Alemberts' Test or Ratio Test.
4. Alternating Series – Leibnitz Test.

UNIT III: **(12 Hours)**
CONTINUITY:
Limits: Real valued Functions, Boundedness of a function, Limits of functions. Some extensions of the limit concept, Infinite Limits. Limits at infinity. (No question is to be set from this portion).
Continuous functions: Continuous functions, Combinations of continuous functions, Continuous Functions on interval.

UNIT IV: **(12 Hours)**
DIFFERENTIATION AND MEAN VALUE THEOREMS: The derivability of a function, on an interval, at a point, Derivability and continuity of a function, Graphical meaning of the Derivative, Mean value Theorems; Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem
UNIT V: **(12 Hours)**
RIEMANN INTEGRATION : Riemann Integral, Riemann integral functions, Darboux theorem. Necessary and sufficient condition for R – integrability, Properties of integrable functions, Fundamental theorem of integral calculus, First mean value Theorem.

Co-Curricular Activities(15 Hours)
Seminar/ Quiz/ Assignments/ Real Analysis and its applications / Problem Solving.
TEXT BOOK:
1. Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, published by John Wiley.

REFERENCE BOOKS:
1. A Text Book of B.Sc Mathematics by B.V.S.S. Sarma and others, published by S. Chand & Company Pvt. Ltd., New Delhi.
2. Elements of Real Analysis as per UGC Syllabus by Shanthi Narayan and Dr. M.D. Raisinghania, published by S. Chand & Company Pvt. Ltd., New Delhi.

B.A/ B.Sc	Semester-IV	Credits:4
Course:5	LINEAR ALGEBRA	Hrs/Weak:5

Course Outcomes:

After successful completion of this course, the student will be able to;

- understand the concepts of vector spaces, subspaces, basises, dimension and their properties.
- understand the concepts of linear transformations and their properties
- apply Cayley- Hamilton theorem to problems for finding the inverse of a matrix and higher powers of matrices without using routine methods
- Learn the properties of inner product spaces and determine orthogonality in inner product spaces.

UNIT I: **(12 Hours)**

Vector Spaces-I: Vector Spaces, General properties of vector spaces, n-dimensional Vectors, addition and scalar multiplication of Vectors, internal and external composition, Null space, Vector subspaces, Algebra of subspaces, Linear Sum of two subspaces, linear combination of Vectors, Linear span Linear independence and Linear dependence of Vectors.

UNIT II: **(12 Hours)**

Vector Spaces-II: Basis of Vector space, Finite dimensional Vector spaces, basis extension, co-ordinates, Dimension of a Vector space, Dimension of a subspace, Quotient space and Dimension of Quotient space.

UNIT III: **(12 Hours)**

Linear Transformations: Linear transformations, linear operators, Properties of L.T, sum and product of LTs, Range and null space of linear transformation, Rank and Nullity of linear transformations – Rank – Nullity Theorem.

UNIT IV: **(12 Hours)**

Matrix : Linear Equations, Characteristic equations, Characteristic Values & Vectors of square matrix, Cayley – Hamilton Theorem.

UNIT V: **(12 Hours)**

Inner product space : Inner product spaces, Euclidean and unitary spaces, Norm or length of a Vector, Schwartz inequality, Triangle Inequality, Parallelogram law, Orthogonality, Orthonormal set, Gram– Schmidt orthogonalisation process. Bessel's inequality and Parseval's Identity.

Co-Curricular Activities **(15 Hours)**

Seminar/ Quiz/ Assignments/ Linear algebra and its applications / Problem Solving.

TEXT BOOK:

1. Linear Algebra by J.N. Sharma and A.R. Vasista, published by Krishna Prakashan Mandir,Meerut- 250002.

REFERENCE BOOKS:

2. Matrices by Shanti Narayana, published by S.Chand Publications.
3. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson Education (low priced edition), New Delhi.
4. Linear Algebra by Stephen H. Friedberg et. al. published by Prentice Hall of India Pvt. Ltd. 4th Edition, 2007.

BLUE PRINT FOR QUESTION PAPER PATTERN
COURSE-I, DIFFERENTIAL EQUATIONS

Unit	TOPIC	S.A.Q (including choice)	E.Q (including choice)	Total Marks
I	Differential Equations of 1^{st} order and 1^{st} Degree	2	2	30
II	Differential Equations of 1^{st} order but not of 1^{st} degree	1	2	25
III	Higher Order Linear Differential Equations (with constant coefficients) – I	2	2	30
IV	Higher Order Linear Differential Equations (with constant coefficients) – II	2	2	30
V	Higher Order Linear Differential Equations (with non constant coefficients)	1	2	25
TOTAL		8	1	140

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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MODEL QUESTION PAPER (Sem-End)
B.A./B.Sc. DEGREE EXAMINATIONS

Semester - I

Course-1: DIFFERENTIAL EQUATIONS

Time: 3Hrs **Max.Marks:75M**

SECTION - A

Answer any FIVE questions. **5 X 5 M=25 M**

1. Solve $\left(1+e^{x/y}\right)dx + e^{x/y}\left(1-\frac{x}{y}\right)dy = 0$
2. Solve $\left(y - e^{\sin^{-1}x}\right)\frac{dx}{dy} + \sqrt{1-x^2} = 0$
3. Solve sin px cos y = cos px siny + p.
4. Solve $[D^2-(a+b)D+ab]y = 0$
5. Solve $(D^2 - 3D + 2) = \cosh x$
6. Solve $(D^2 - 4D + 3)y = \sin 3x \cos 2x$.
7. Solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 13y = 8e^{3x}\sin 2x$.
8. Solve $x^2y'' - 2x(1+x)y' + 2(1+x)y = x^3$

SECTION - B

Answer ALL the questions. **5 X 10 M = 50 M**

9. (a) Solve $\cancel{x}\frac{dy}{dx} + y = y^2 \log x$.

(Or)

(b) Solve $\left(y + \frac{y^3}{3} + \frac{x^2}{2}\right)dx + \frac{1}{4}(x + xy^2)dy = 0$

10. (a) Solve $p^2 + 2py\cot x = y^2$.

(Or)

(b) Solve $y + Px = P^2x^4$

11. (a) Solve$(D^3 + D^2 - D - 1)y = \cos 2x$.11

(OR)

(b) Solve $(D^2 - 3D + 2)y = \sin e^{-x}$.

12. (a) Solve $(D^2 - 2D + 4)y = 8(x^2 + e^{2x} + \sin 2x)$

(Or)

(b) Solve $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = xe^x \sin x$

13. (a) Solve $(D^2 - 2D)\ y = e^x \sin x$ by the method of variation of parameters.

(Or)

(b) Solve $3x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = x$

BLUE PRINT FOR QUESTION PAPER PATTERN

COURSE-II, THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY

Unit	TOPIC	S.A.Q (including choice)	E.Q (including choice)	Total Marks
I	The Plane	2	2	30
II	The Right Line	2	2	30
III	The Sphere	2	2	30
IV	The Sphere & The Cone	1	2	25
V	The Cone	1	2	25
Total		8	10	140

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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MODEL QUESTION PAPER (Sem-End)
B.A./B.Sc. DEGREE EXAMINATIONS

Semester - II

Course-2: THREE DIMENSIONAL ANALYTICAL SOLID GEOMETRY

Time: 3Hrs **Max.Marks:75M**

SECTION - A

Answer any FIVE questions. **5 X 5 M=25 M**

1. Find the equation of the plane through the point (-1,3,2) and perpendicular to the planesx+2y+2z=5 and 3x+3y+2z=8.
2. Find the bisecting plane of the acute angle between the planes 3x-2y-6z+2=0,-2x+y-2z-2=0.
3. Find the image of the point (2,-1,3) in the plane 3x-2y+z =9.

4. Show that the lines $2x + y - 4 = 0 = y + 2z$ and $+ 3z - 4 = 0$, $2x + 5z - 8 = 0$ are coplanar.

5. A variable plane passes through a fixed point (a, b, c). It meets the axes in A, B, C. Show that thecentre of the sphere OABC lies on $ax^{-1}+by^{-1}+cz^{-1}=2$.
6. Show that the plane 2x-2y+z+12=0 touches the sphere $x^2+y^2+z^2-2x-4y+2z-3=0$ and find the pointof contact.
7. Find the equation to the cone which passes through the three coordinate axes and the lines $\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and $\frac{x}{2} = \frac{y}{1} = \frac{z}{1}$
8. Find the equation of the enveloping cone of the sphere $x^2 + y^2 + z^2 + 2x - 2y = 2$ withits vertex at (1, 1, 1).

SECTION - B

Answer ALL the questions. **5 X 10 M = 50 M**

9. (a) A plane meets the coordinate axes in A, B, C. If the centroid of ΔABc (a,b,c), show that theEquation of the plane is $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 3.$

(OR)

(b) A variable plane is at a constant distance p from the origin and meets the axes in A,B,C. Show thatThe locus of the centroid of the tetrahedron OABC is $x^{-2}+y^{-2}+z^{-2}=16p^{-2}$.

10. (a) Find the shortest distance between the lines $\frac{x-3}{3}=\frac{y-8}{-1}=\frac{z-3}{1}$; $\frac{x+3}{-3}=\frac{y+7}{2}=\frac{z-6}{4}$.

(OR)

(b) Prove that the lines $\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-3}{4}$; $\frac{x-2}{3}=\frac{y-3}{4}=\frac{z-4}{5}$ are coplanar. Also find their point ofintersection and the plane containing the lines.

11. (a) Show that the two circles $x^2+y^2+z^2-y+2z=0$, $x-y+z=2$;$x^2+y^2+z^2+x-3y+z-5=0$, $2x-y+4z-1=0$lie on the same sphere and find its equation.

(OR)

(b) Find the equation of the sphere which touches the plane $3x+2y-z+2=0$ at $(1,-2,1)$ and cuts orthogonallyThe sphere $x^2+y^2+z^2-4x+6y+4=0$.

12. (a) Find the limiting points of the coaxial system of spheres $x^2+y^2+z^2-8x+2y-2z+32=0$,$x^2+y^2+z^2-7x+z+23=0$.

(OR)

(b) Find the equation to the cone with vertex is the origin and whose base curve is $x^2+y^2+z^2+2ux+d=0$.

13 (a) Prove that the equation $\sqrt{fx} \pm \sqrt{gy} \pm \sqrt{hz} = 0$ represents a cone that touches the coordinatePlanes and find its reciprocal cone.

(OR)

(b) Find the equation of the sphere $x^2+y^2+z^2-2x+4y-1=0$ having its generators parallel to the line $x=y=z$.

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COURSE-III, ABSTRACT ALGEBRA

Unit	TOPIC	S.A.Q(including choice)	E.Q(including choice)	Total Marks
I	Groups	2	2	30
II	Subgroups, Cosets & Lagrange's theorem	1	2	25
III	Normal Subgroups	1	2	25
IV	Homomorphism and Permutations	2	2	30
V	Rings	2	2	30
Total		8	10	140

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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MODEL QUESTION PAPER (Sem-End)
B.A./B.Sc. DEGREE EXAMINATIONS

Semester - III

Course-3: ABSTRACT ALGEBRA

Time: 3Hrs **Max.Marks:75M**

SECTION – A

Answer any FIVE questions. **5 X 5 M=25 M**

1. Show that the set G=$\{x/x = 2^a3^b \text{ and } a,b \in Z\}$ is a group under multiplication
2. Define order of an element. In a group G, prove that if $a \in G$ then $O(a) = O(a)^{-1}$.
3. If H and K are two subgroups of a group G, then prove that HK is a subgroup ⇔ HK=KH
4. If G is a group and H is a subgroup of index 2 in G then prove that H is a normal subgroup.
5. Examine whether the following permutations are even or odd

   i) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ 6 & 1 & 4 & 3 & 2 & 5 & 7 & 8 & 9 \end{pmatrix}$ ii) $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 3 & 2 & 4 & 5 & 6 & 7 & 1 \end{pmatrix}$
6. If f is a homomorphism of a group G into a group G', then prove that the kernel of f is a normal of G.
7. Prove that the characteristic of an integral domain is either prime or zero.
8. Define a Boolean Ring and Prove that the Characteristic of a Boolean Ring is 2.

SECTION - B

Answer ALL the questions. **5 X 10 M = 50 M**

9. a) Show that the set of n^{th} roots of unity forms an abelian group under multiplication.

   (Or)

   b) In a group G, for $a, b \in G$, O(a)=5, b ≠ e and $aba^{-1} = b^2$. Find O(b).

10. a) The Union of two subgroups is also a subgroup □ one is contained in the other.

    (Or)

    b) State and prove Langrage's theorem.

11. a) Prove that a subgroup H of a group G is a normal subgroup of G iff the product of two right cosets of H in G is again a right coset of H in G.

    (Or)

    b) Define Normal Subgroup. Prove that a subgroup H of a group G is normal iff $xHx^{-1} = H \ \forall x \in G$.

12. a) State and prove fundamental theorem of homomorphisms of groups.

    (Or)

    b) Let S_n be the symmetric group on n symbols and let A_n be the group of even permutations. Then show that A_n is normal in S_n and O(A_n) = $\frac{1}{2}(n!)$

13. a) Prove that every finite integral domain is a field.

    (Or)

    b) Let S be a non empty sub set of a ring R. Then prove that S is a sub ring of R if and only if a-b ∈ S and ab ∈ S for all a, b ∈ S.

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COURSE-IV, REAL ANALYSIS

Unit	**TOPIC**	**S.A.Q**(including choice)	**E.Q**(including choice)	**Total Marks**
I	Real Sequence	1	2	25
II	Infinite Series	2	2	30
III	Limits and Continuity	1	2	25
IV	Differentiation and Mean Value Theorem	2	2	30
V	Riemann Integration	2	2	30
	TOTAL	8	10	140

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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MODEL QUESTION PAPER (Sem-End)

B.A./B.Sc. DEGREE EXAMINATIONS

Course-4: REAL ANALYSIS

Time: 3Hrs **Max.Marks:75M**

SECTION - A

Answer any FIVE questions. **5 X 5 M=25 M**

1. Prove that every convergent sequence is bounded.
2. Examine the convergence of $\frac{1}{1.2} - \frac{1}{3.4} + \frac{1}{5.6} - \frac{1}{7.8} + \cdots$
3. Test the convergence of the series $\sum_{n=1}^{\infty}\left(\sqrt[3]{n^3+1} - n\right)$.
4. Examine for continuity of the function f defined by $f(x) = |x| + |x-1|$ at x=0 and 1.
5. Show that $f(x) = x\sin\frac{1}{x},\ x \neq 0; f(x) = 0, x = 0$ is continuous but not derivable at x=0.
6. Verify Rolle's theorem for the function $f(x) = x^3 - 6x^2 + 11x - 6$ on $[1,3]$.
7. If $f(x) = x^2\ \forall\ x \in [0,1]$ and $p = \{0, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, 1\}$ then find L(p, f) and U(p, f).
8. Prove that if $f: [a,b] \to R$ is continuous on [a, b] then f is R- integrable on [a, b].

SECTION –B

Answer ALL the questions. **5 X 10 M = 50 M**

9. (a) If $s_n = 1 + \frac{1}{2!} + \frac{1}{3!} + - - - - - - - + \frac{1}{n!}$ then show that $\{s_n\}$ converges.

(OR)

(b) State and prove Cauchy's general principle of convergence.

10. (a) State and Prove Cauchy's nth root test.

(OR)

(b) Test the convergence of $\sum \frac{x^n}{x^n + a^n}$ $(x > 0, a > 0)$

11. (a) Let f: R→ R be such that

$$f(x) = \frac{\sin(a+1)x + \sin x}{x} \quad \text{for } x < 0$$
$$= c \quad \text{for } x = 0$$
$$= \frac{(x+bx^2)^{1/2} - x^{1/2}}{bx^{3/2}} \quad \text{for } x > 0$$

Determine the values of a, b, c for which the function f is continuous at x=0.

(OR)

(b) If f: [a, b] → R is continuous on [a, b] then prove that f is bounded on [a, b]

12. (a) Using Lagrange's theorem, show that $x > \log(1+x) > \frac{x}{(1+x)} \forall x > 0$.

(OR)

(b) State and prove Cauchy's mean value theorem...

13. (a) State and prove Riemman's necessary and sufficient condition for R- integrability.

(OR)

(b) Prove that $\frac{\pi^3}{24} \leq \int_0^\pi \frac{x^2}{5+3\cos x} dx \leq \frac{\pi^3}{6}$

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COURSE-V, LINEAR ALGEBRA

Unit	TOPIC	S.A.Q (including choice)	E.Q (including choice)	Marks Allotted
I	Vector spaces - I	2	2	30
II	Vector spaces - II	1	2	25
III	Linear Transformation	2	2	30
IV	Matrices	1	2	25
V	Inner product spaces	2	2	30
Total		8	10	140

S.A.Q. = Short answer questions (5 marks)

E.Q. = Essay questions (10 marks)

Short answer questions : 5 X 5 M = 25 M

Essay questions : 5 X 10 M = 50 M

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Total Marks = 75 M

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MODEL QUESTION PAPER (Sem-End)

B.A./B.Sc. DEGREE EXAMINATIONS

Semester -IV

Course-5: LINEAR ALGEBRA

Time: 3Hrs **Max.Marks:75M**

SECTION - A

Answer any FIVE questions. **5 X 5M=25 M**

1. Let p, q, r be fixed elements of a field F. Show that the set W of all triads (x, y, z) of elements of F, such that px+qy+rz=0 is a vector subspace of $V_3(R)$.
2. Define linearly independent &linearly dependent vectors in a vector space. If α, β, γ are linearly independent vectors of $V(R)$ then show that $\alpha+\beta, \beta+\gamma, \gamma+\alpha$ are also linearly independent.
3. Prove that every set of $(n+1)$ or more vectors in an n dimensional vector space is linearly dependent.
4. The mapping T : V3(R) V3(R) is defined by T(x,y,z) = (x-y,x-z). Show that T is a linear ransformation.
5. Let $T: R^3 \rightarrow R^2$ and $H: R^3 \rightarrow R^2$ be defined by T (x, y, z)= (3x, y+z) and H (x, y, z)= (2x-z, y). Compute i) T+H ii) 4T-5H iii) TH iv) HT.
6. If the matrix A is non-singular, show that the eigen values of A^{-1} are the reciprocals of the eigen values of A.
7. State and prove parallelogram law in an inner product space V(F).
8. Prove that the set S = $\left\{\left(\frac{1}{3}, \frac{-2}{3}, \frac{-2}{3}\right), \left(\frac{2}{3}, \frac{-1}{3}, \frac{2}{3}\right), \left(\frac{2}{3}, \frac{2}{3}, \frac{-1}{3}\right)\right\}$ is an orthonormal set in the inner product space $R^3(R)$ with the standard inner product.

SECTION - B

Answer ALL the questions. **5 X 10 M = 50 M**

9. (a) Define vector space. Let V (F) be a vector space. Let W be a non empty sub set of V. Prove that the Necessary and sufficient condition for W to be a subspace of V is $a, b \in F$ and $\alpha, \beta \in V \Rightarrow a\alpha + b\beta \in W$

(OR)

(b) Prove that the four vectors (1,0,0), (0,1,0), (0,0,1) and (1,1,1) of $V_3(C)$ form linearly dependent set, but any three of them are linearly independent.

10. (a) Define dimension of a finite dimensional vector space. If W is a subspace of a finite Dimensional vector space V (F) then prove that W is finite dimensional and dim W $\leq n$.

(OR)

(b) If W be a subspace of a finite dimensional vector space V(F) then Prove that

. $\dim {}^{V}/_{W} = \dim V - \dim W$

11. (a) Find T (x, y, z) where $T: R^3 \rightarrow R$ is defined by T (1, 1, 1) =3, T (0, 1, -2) =1,T (0, 01) = -2

(OR)

(b) State and prove Rank Nullity theorem.

12. (a) Find the eigen values and the corresponding eigen vectors of the matrix A= $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$

(OR)

(b) State and prove Cayley-Hamilton theorem.

13. (a) State and prove Schwarz's inequality in an Inner product space V(F).

(OR)

(b) Given $\{(2,1,3),(1,2,3),(1,1,1)\}$ is a basis of R^3(R).Construct an orthonormal basis using Gram-Schmidorthogonalisation process.

Skill Enhancement Courses (SECs) for Semester -V,

From 2022-23(Syllabus-Curriculum)
<u>Structure of SECs for Semester–V</u>

(To choose One pair from the Four alternate pairs of SECs)

Univ Code	Course Number 6&7	Name of Course	Hours/ Week	Credits	Marks	
					IA–20 Filed Work 05	Sem End
	6A	Numerical Methods	**6**	**5**	**25**	**75**
	7A	Mathematical Special Functions	**6**	**5**	**25**	**75**

OR

	6B	Multiple integrals and Applications of Vector Calculus	**6**	**5**	**25**	**75**
	7B	Integral transforms with Applications	**6**	**5**	**25**	**75**

OR

	6C	Partial Differential Equations and Fourier Series	**6**	**5**	**25**	**75**
	7C	Number theory	**6**	**5**	**25**	**75**

Note: *Course type code: T: Theory, L: Lab, P: Problem solving

***Note**: FIRST and SECOND PHASES (2 spells) of APPRENTICESHIP between 1st and 2nd year and between 2nd and 3rd year (two summer vacations)

***Note**: THIRD PHASE of APPRENTICESHIP Entire 5th / 6th Semester

Note-1: For Semester–V, for the domain subject Mathematics, any one of the three pairs of SECs shall be chosen as courses 6 and 7, i.e., (6A & 7A) or (6B & 7B) or (6C & 7C),the pair shall not be broken. A, B, C allotment is random, not on any priority basis.

Note-2: One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in the syllabus citing related real field situations.

B. A/B.Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:
Course: 6A	Numerical Methods	Hrs/Wk:

Learning Outcomes:

Students after successful completion of the course will be able to

1. understand the subject of various numerical methods that are used to obtain approximate solutions
2. Understand various finite difference concepts and interpolation methods.
3. Work out numerical differentiation and integration whenever and wherever routine methods are not applicable.
4. Find numerical solutions of ordinary differential equations by using various numerical methods.
5. Analyze and evaluate the accuracy of numerical methods.

Syllabus :(Hours: Teaching: 75 (incl. unit tests etc. 05), Training: 15)

Unit – 1: Finite Differences and Interpolation with Equal intervals (15h)

1. Introduction, Forward differences, Backward differences, Central Differences, Symbolic relations, nth Differences of Some functions,
2. Advancing Difference formula, Differences of Factorial Polynomial.
3. Newton's formulae for interpolation. Central Difference Interpolation Formulae.

Unit – 2: Interpolation with Equal and Unequal intervals (15h)

1. Central Difference Interpolation Formulae.

   Gauss's Forward interpolation formula, Gauss's backward interpolation formula, Stirling's formula, Bessel's formula.
2. Interpolation with unevenly spaced points, divided differences and properties, Newton's divided differences formula.
3. Lagrange's interpolation formula, Lagrange's Inverse interpolation formula.

Unit – 3: Numerical Differentiation (15h)

1. Derivatives using Newton's forward difference formula, Newton's back ward difference formula,
2. Derivatives using central difference formula, Stirling's interpolation formula,
3. Newton's divided difference formula, Maximum and minimum values of a tabulated function.

Unit – 4: Numerical Integration (15h)

1. General quadrature formula one errors, Trapezoidal rule,
2. Simpson's1/3– rule, Simpson's 3/8 – rule, and Weddle's rules,
3. Euler – McLaurin Formula of summation and quadrature, The Euler transformation.

Unit – 5: Numerical solution of ordinary differential equations (15h)

1. Introduction, Solution by Taylor's Series,
2. Picard's method of successive approximations,
3. Euler's method, Modified Euler's method, Runge – Kutta methods.

References:

1. S.S.Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi-110001, 2006.
2. P.Kandasamy, K.Thilagavathy, Calculus of Finite Differences and Numerical Analysis. S. Chand & Company, Pvt. Ltd., Ram Nagar, New Delhi-110055.
3. R.Gupta, Numerical Analysis, Laxmi Publications (P) Ltd., New Delhi.
4. H.C Saxena, Finite Differences and Numerical Analysis, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
5. S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr.V.Ramesh Babu, Numerical Analysis, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
6. Web resources suggested by the teacher and college librarian including reading material.

Co-Curricular Activities:

A) Mandatory:

1. For Teacher: Teacher shall train students in the following skills for 15 hours, by taking relevant outside data (Field/Web).

1. Applications of Newton's forward and back ward difference formulae.
2. Applications of Gauss forward and Gauss back ward, Stirling's and Bessel's formulae.
3. Applications of Newton's divided differences formula and Lagrange's interpolation formula.
4. Various methods to find the approximation of a definite integral.
5. Different methods to find solutions of Ordinary Differential Equations.

2. For Student: Fieldwork/Project work; Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following**,** by choosing any one of the aspects.

1. Collecting the data from the identified sources like Census department or Electricity department, by applying the Newton's, Gauss and Lagrange's interpolation formula, making observations and drawing conclusions. (Or)
2. Selection of some region to find the area by applying Trapezoidal rule, Simpson's1/3– rule, Simpson's 3/8 – rule, and Weddle's rules. Comparing the solutions with analytical solution and concluding which one is the best method. (Or)

3.Findingsolutionof the ODE by Taylor's Series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge–Kutta methods. Comparing the solutions with analytical solution, selecting the best method.

3. Max. Marks for Fieldwork/Project work Report: 05.

4. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area.

B. A/B.Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:
Course: 7A	Mathematical Special Functions	Hrs/Wk:

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the Beta and Gamma functions, their properties and relation between these two functions, understand the orthogonal properties of Chebyshev polynomials and recurrence relations.
2. Find power series solutions of ordinary differential equations.
3. solve Hermite equation and write the Hermite Polynomial of order (degree) n, also find the generating function for Hermite Polynomials, study the orthogonal properties of Hermite Polynomials and recurrence relations.
4. Solve Legendre equation and write the Legendre equation of first kind, also find the generating function for Legendre Polynomials, understand the orthogonal properties of Legendre Polynomials.
5. Solve Bessel equation and write the Bessel equation of first kind of order n, also find the generating function for Bessel function understand the orthogonal properties of Bessel function.

Syllabus: (Hours: Teaching: 75 (incl. unit tests etc. 05), Training: 15)

Unit – 1: Beta and Gamma functions. (15h)

1. Euler's Integrals-Beta and Gamma Functions, Elementary properties of Gamma Functions.
2. Transformation of Gamma Functions. Another form of Beta Function,
3. Relation between Beta and Gamma Functions.

CHAPTER: 2.9 to 2.15 of Prescribed text book 1

Unit – 2: Power series and Power series solutions of ordinary differential equations (15h)

1. Introduction, summary of useful results, power series, radius of convergence, theorems on Power series
2. Introduction of power series solutions of ordinary differential equation
3. Ordinary and singular points, regular and irregular singular points, power series solution.

CHAPTER: 7.1to 7.8 and 8.1 to 8.6 of Part-II of Prescribed text book 2

Unit – 3: Hermite polynomials (15h)

1. Hermite Differential Equations, Solution of Hermite Equation, Hermite polynomials, generating function for Hermite polynomials.
2. Other forms for Hermite Polynomials, Rodrigues formula for Hermite Polynomials, to find first few Hermite Polynomials.
3. Orthogonal properties of Hermite Polynomials, Recurrence formulae for Hermite Polynomials.

CHAPTER: 6.1 to 6.8 of Prescribed text book 1

Unit – 4: Legendre polynomials (15h)

1. Definition, Solution of Legendre's equation, Legendre polynomial of degree n, generating function of Legendre polynomials.
2. Definition of $P_n(x)$ and $Q_n(x)$, General solution of Legendre's Equation (derivations not required) to show that $\mathrm{Pn}(x)$ is the coefficient of h^n, in the expansion of $(1-2xh+h^2)^{\frac{-1}{2}}$
3. Orthogonal properties of Legendre's polynomials, Recurrence formulas for Legendre's Polynomials.

CHAPTER: 2.1 to 2.8 and 2.12 of Prescribed text book 1

Unit – 5: Bessel's equation (15h)

1. Definition, Solution of Bessel's equation, Bessel's function of the first kind of order n, Bessel's function of the second kind of order n.
2. Integration of Bessel's equation in series form=0, Definition of $J_n(x)$, recurrence formulae for $J_n(x)$.
3. Generating function for $J_n(x)$.

CHAPTER: 5.1 to 5.7 of Prescribed text book 1

Prescribed Books:

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. J.N.Sharma and Dr.R.K.Gupta, Differential equations with special functions, Krishna Prakashan Mandir.

Reference Books:

1. Shanti Narayan and Dr.P.K.Mittal, Integral Calculus, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. George F.Simmons, Differential Equations with Applications and Historical Notes, Tata McGRAW-Hill Edition, 1994.
3. Shepley L.Ross, Differential equations, Second Edition, John Willy & sons, New York, 1974.
4. Web resources suggested by the teacher and college librarian including reading material.

Co-Curricular Activities:

A) Mandatory:

1. For Teacher: Teacher shall train students in the following skills for 15 hours, by taking relevant outside data (Field/Web).

1. Beta and Gamma functions, Chebyshev polynomials.
2. Power series, power series solutions of ordinary differential equations,
3. Procedures of finding series solutions of Hermite equation, Legendre equation and Bessel equation.
4. Procedures of finding generating functions for Hermite polynomials, Legendre Polynomials and Bessel's function.

2. For Student: Fieldwork/Project work; Each student individually shall undertake Fieldwork/Project work, make observations and conclusions and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following**,** by choosing any one of the aspects.

1. Going through the web sources like Open Educational Resources on the properties of Beta and Gamma functions, Chebyshev polynomials, power series solutions of ordinary differential equations. (or)

2. Going through the web sources like Open Educational Resources on the properties of series solutions of Hermite equation, Legendre equation and Bessel equation.

3. Max. Marks for Fieldwork/Project work Report: 05.

4. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area.

B. A/B.Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:
Course: 6B	Multiple Integrals And Applications Of Vector Calculus	Hrs/Wk:

Learning Outcomes:

Students after successful completion of the course will be able to

1. Learn multiple integrals as a natural extension of definite integral to a function of two variables in the case of double integral / three variables in the case of triple integral.
2. Learn applications in terms of finding surface area by double integral and volume by triple integral.
3. Determine the gradient, divergence and curl of a vector and vector identities.
4. Evaluate line, surface and volume integrals.
5. understand relation between surface and volume integrals (Gauss divergence theorem), relation between line integral and volume integral (Green's theorem), relation between line and surface integral (Stokes theorem)

Syllabus: (Hours: Teaching: 75 (incl. unit tests etc.05), Training: 15)

Unit – 1: Multiple integrals-I (15h)

1. Introduction, Double integrals, Evaluation of double integrals, Properties of double integrals.
2. Region of integration, double integration in Polar Co-ordinates,
3. Change of variables in double integrals, change of order of integration.

Unit – 2: Multiple integrals-II (15h)

1. Triple integral, region of integration, change of variables.
2. Plane areas by double integrals, surface area by double integral.
3. Volume as a double integral, volume as a triple integral.

Unit – 3: Vector differentiation (15h)

1. Vector differentiation, ordinaryderivatives of vectors.
2. Differentiability, Gradient, Divergence, Curl operators,
3. Formulae involving the separators.

Unit – 4: Vector integration (15h)

1. Line Integrals with examples.
2. Surface Integral with examples.
3. Volume integral with examples.

Unit – 5: Vector integration applications (15h)

1. Gauss theorem and applications of Gauss theorem.
2. Green's theorem in plane and applications of Green's theorem.
3. Stokes's theorem and applications of Stokes theorem.

Reference Books:

4.Dr.M Anitha, Linear Algebra and Vector Calculus for Engineer, Spectrum University Press, SR Nagar, Hyderabad-500038, INDIA.
5.Dr.M.Babu Prasad, Dr.K.Krishna Rao, D.Srinivasulu, Y.AdiNarayana, Engineering Mathematics-II, Spectrum University Press, SR Nagar, Hyderabad-500038,INDIA.
6. V.Venkateswararao, N. Krishnamurthy, B.V.S.S.Sarma and S.Anjaneya Sastry, A text Book of B.Sc., Mathematics Volume-III, S. Chand & Company, Pvt. Ltd., Ram Nagar,NewDelhi-110055.
7. R.Gupta,Vector Calculus, Laxmi Publications.
8. P.C.Matthews, Vector Calculus, Springer Verlag publications.
9. Web resources suggested by the teacher and college librarian including reading material.

Co-Curricular Activities:

A) Mandatory:

1. **For Teacher:** Teacher shall train students in the following skills for 15 hours, by taking Relevant outside data (Field/Web).
   1. The methods of evaluating double integrals and triple integrals in the class room and train to evaluate
   These integrals of different functions over different regions.
   2. Applications of line integral, surface integral and volume integral.
   3. Applications of Gauss divergence theorem, Green's theorem and Stokes's theorem.
2. **For Student: Fieldwork/Project work** Each student individually shall undertake Fieldwork/Project work and submit a
   report not exceeding 10 pages in the given format on the work-done in the areas like
   the following**,** by choosing any one of the following aspects.
   1. Going through the web sources like Open Educational Resources to find the values of double and triple integrals of specific functions in a given region and make conclusions. (or)
   2. Going through the web sources like Open Educational Resources to evaluate line integral, surface integral and volume integral and apply Gauss divergence theorem, Green's theorem and Stokes theorem and make conclusions.

3. Max. Marks for Fieldwork/Project work Report: 05.
4. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

4. Unit tests (IE).

b) Suggested Co-Curricular Activities:
1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified are

B. A/B.Sc	Semester – V (Skill Enhancement Course- Elective)	Credits:
Course: 7B	Integral Transforms With Applications	Hrs/Wk:

Learning Outcomes:

Students after successful completion of the course will be able to

1. Evaluate Laplace transforms of certain functions, find Laplace transforms of derivatives and of integrals.
2. Determine properties of Laplace transform which may be solved by application of special functions namely Dirac delta function, error function, Bessel function and periodic function.
3. Understand properties of inverse Laplace transforms, find inverse Laplace transforms of derivatives and of integrals.
4. Solve ordinary differential equations with constant/ variable coefficients by using Laplace transform method.
5. Comprehend the properties of Fourier transforms and solve problems related to finite Fourier transforms.

Syllabus :(Hours: Teaching: 75 (incl. unit tests etc.05), Training: 15)

Unit – 1: Laplace transforms- I (15h)

1. Definition of Laplace transform, linearity property-piecewise continuous function.
2. Existence of Laplace transform, functions of exponential order and of class A.
3. First shifting theorem, second shifting theorem and change of scale property.

Unit – 2: Laplace transforms- II (15h)

1. Laplace Transform of the derivatives, initial value theorem and final value theorem. Laplace transforms of integrals.
2. Laplace transform of t^n. f (t), division by t, evolution of integrals by Laplace transforms.
3. Laplace transform of some special functions-namely Dirac delta function, error function, Bessel function and Laplace transform of periodic function.

Unit – 3: Inverse Laplace transforms (15h)

1. Definition of Inverse Laplace transform, linear property, first shifting theorem, second shifting theorem, change of scale property, use of partial fractions.
2. Inverse Laplace transforms of derivatives, inverse, Laplace transforms of integrals, multiplication by powers of 'p', division by 'p'.
3. Convolution, convolution theorem proof and applications.

Unit – 4: Applications of Laplace transforms (15h)

1. Solutions of differential equations with constants coefficients, solutions of differential equations with variable coefficients.
2. Applications of Laplace transforms to integral equations- Abel's integral equation.
3. Converting the differential equations into integral equations, converting the integral equations into differential equations.

Unit – 5: Fourier transforms (15h)

1. Integral transforms, Fourier integral theorem (without proof), Fourier sine and cosine integrals.
2. Properties of Fourier transforms, change of scale property, shifting property, modulation theorem. Convolution.
3. Convolution theorem for Fourier transform, Parseval's Identify, finite Fourier transforms.

Reference Books:

1. Dr. S.Sreenadh, S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr. V.Ramesh Babu, Fourier series and Integral Transforms, S. Chand & Company, Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. A.R. Vasistha, Dr. R.K. Gupta, Laplace Transforms, Krishna Prakashan Media Pvt. Ltd.Meerut.
3. M.D.Raisinghania, H.C. Saxsena , H.K. Dass, Integral Transforms, S. Chand & CompanyPvt. Ltd., Ram Nagar, New Delhi-110055.
4. Dr. J.K. Goyal, K.P. Gupta, Laplace and Fourier Transforms, Pragathi Prakashan, Meerut.
5. Shanthi Narayana , P.K. Mittal, A Course of Mathematical Analysis, S. Chand & CompanyPvt.Ltd. Ram Nagar, New Delhi-110055.
6. Web resources suggested by the teacher and college librarian including reading material.

Co-Curricular Activities:

A) Mandatory:

1. For Teacher: Teacher shall train students in the following skills for 15 hours, by taking Relevant outside data (Field/Web).

1. Demonstrate on sufficient conditions for the existence of the Laplace transform of a function.
2. Evaluation of Laplace transforms and methods of finding Laplace transforms.
3. Evaluations of Inverse Laplace transforms and methods of finding Inverse Laplace transforms.
4. Fourier transforms and solutions of integral equations.

2. For Student: Fieldwork/Project work; Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like thefollowing, by choosing any one of the aspects.

1. Going through the web sources like Open Educational Resources on Applications of Laplace transforms and Inverse Laplace transforms to find solutions of ordinary differential equations with constant /variable coefficients and make conclusions. (or)
2. Going through the web sources like Open Educational Resources on Applications of convolution theorem to solve integral equations and make conclusions. (or)
3. Going through the web source like Open Educational Resources on Applications of Fourier transforms to solve integral equations and make conclusions.
4. **Max. Marks for Fieldwork/Project work Report: 05.**

3. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

4. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area.

B. A/B.Sc	**Semester – V (Skill Enhancement Course- Elective)**	**Credits:**
Course: 6C	**Partial differential equations & Fourier series**	**Hrs/Wk:**

Learning Outcomes:

Students after successful completion of the course will be able to

1. Classify partial differential equations, formation of partial differential equations and solve Cauchy's problem for first order equations.
2. Solve Lagrange's equations by various methods, find integral Surface passing through a given curve and Surfaces orthogonal to a given system of Surfaces.
3. Find solutions of nonlinear partial differential equations of order one by using Char pit's method.
4. Find solutions of nonlinear partial differential equations of order one by using Jacobi's method.
5. Understand Fourier series expansion of a function f(x) and Parseval's theorem.

Syllabus: (Hours: Teaching: 75 (incl. unit tests etc.05), Training: 15)

Unit – 1: Introduction of partial differential equations (15h)

1. Partial Differential Equations, classification of first order partial differential equations, Rule I, derivation of a partial differential equations by the elimination of arbitrary constants
2. Rule II, derivation of a partial differential equation by the elimination of arbitrary function φ from the equations $\emptyset(u, v) = 0$ where u and v are functions of x, y and z.
3. Cauchy's problem for first order equations

Unit – 2: Linear partial differential equations of order one (15h)

1. Lagrange's equations, Lagrange's method of solving Pp+Qq=R, where P, Q and R are functions of x, y and z, type 1 based on Rule I for solving $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$, type 2 based on Rule II for solving $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$.
2. Type 3 based on Rule III for solving $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$, type 4 based on Rule IV for solving $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$.
3. Integral Surface passing through a given curve, the Cauchy problem, Surfaces orthogonal to a given system of Surfaces.

Unit – 3: Non-linear partial differential equations of order one-I (15h)

1. Complete integral, particular integral, singular integral and general integral, geometrical interpretation of integrals of f (x, y, z, p, q) = 0, method of getting singular integral from the PDE of first order, compatible system of first order equations.
2. Char pit's method, Standard form I, only p and q present.
3. Standard form II, Clairaut equations.

Unit – 4: Non-linear partial differential equations of order one-II (15h)

1. Standard Form III, only p, q and z present.
2. Standard Form IV, equation of the form$f_1(x, p) = f_2(y, q)$.
3. Jacobi's method, Jacobi's method for solving partial differential equations with three or more independent variables, Jacobi's method for solving a non-linear first order partial differential equations in two independent variables.

Unit – 5: Fourier series (15h)

1. Introduction, Euler's formulae for Fourier series expansion of a function f(x), Dirichlet's conditions for Fourier series, convergence of Fourier series.
2. Functions having arbitrary periods. Change of interval, Half range series.
3. Parseval's theorem, illustrative examples based on Parseval's theorem, some particular series.

Reference Books:

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. Dr. S.Sreenadh, S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr. V.Ramesh Babu, Fourier Series and Integral Transforms, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
3. Prof T.Amaranath, An Elementary Course in Partial Differential Equations Second Edition, Narosa Publishing House, New Delhi.
4. Fritz John, Partial Differential Equations, Narosa Publishing House, New Delhi, 1979.
5. I.N.Sneddon, Elements of Partial Differential Equations by McGraw Hill, International Edition, Mathematics series.
6. Web resources suggested by the teacher and college librarian including reading material.

Co-Curricular Activities:

A) Mandatory:

1. For Teacher: Teacher shall train students in the following skills for 15 hours, by taking Relevant outside data (Field/Web).

1. On classification of first order partial differential equations, formation of partial differential equations.
2. Various methods of finding solutions of partial differential equations.
3. Integral Surface passing through a given curve and Surfaces orthogonal to a give system of Surfaces.

b) For Student: Fieldwork/Project work; Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the

Following**,** by choosing any one of the aspects.

1. Going through the web source like Open Educational Resources to find solutions of partial differential equations by using Lagrange's method, Charpit's method and Jacobi's method and make conclusions. (or)
2. Going through the web source like Open Educational Resources to find Integral Surface passing through a given curve and Surfaces orthogonal to a given system of Surfaces and make conclusions. (or)
3. Going through the web source like Open Educational Resources to find Fourier series expansions of some functions and applications of Parseval's theorem and make conclusions.

3. Max. Marks for Fieldwork/Project work Report: 05.

4. Suggested Format for Fieldwork/Project work Report: Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

5. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area.

B. A/B.Sc	**Semester – V (Skill Enhancement Course- Elective)**	**Credits:**
Course: 7C	**Number Theory**	**Hrs/Wk:**

Learning Outcomes:

Students after successful completion of the course will be able to

4. Find quotients and remainders from integer division, study divisibility properties of integers and the distribution of primes.
5. Understand Dirichlet multiplication which helps to clarify interrelationship between various arithmetical functions.
6. Comprehend the behaviour of some arithmetical functions for large n.
7. Understand the concepts of congruencies, residue classes and complete residues systems.
8. Comprehend the concept of quadratic residues mod p and quadratic non residues mod p.

Syllabus: (Hours: Teaching:75 (incl. unit tests etc.05), Training:15)

Unit – 1: Divisibility (15h)

1. Introduction, Divisibility, Greatest Common Divisor.
2. Prime numbers, The fundamental theorem of arithmetic, The series of reciprocals of the primes.
3. The Euclidean algorithm, The greatest common divisor of more than two numbers.

Unit – 2: Arithmetical Functions and Dirichlet Multiplication (15h)

1. Introduction, The Mobius function$\mu(n)$, The Euler totient function$\varphi(n)$, A relation connecting φ and μ , A product formula for $\varphi(n)$.
2. The Dirichlet product of arithmetical functions, Dirichlet inverses and Mobius inversion formula, The Mangoldt function$\Lambda(n)$.
3. Multiplicative functions, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function $\lambda(n)$, The divisor functions $\sigma_\alpha(n)$.

Unit – 3: Averages of Arithmetical Functions (15h)

1. Introduction, The big oh notation. Asymptotic equality of functions, Euler's summation formula, some elementary asymptotic formulas.
2. The average order of $d(n)$, The average order of the divisor functions$\sigma_\alpha(n)$, The average order of $\varphi(n)$.
3. The average order of $\mu(n)$ and $\Lambda(n)$, The partial sum of a Dirichlet product, Applications of $\mu(n)$ and $\Lambda(n)$.

Unit – 4: Congruences (15h)

1. Definition and basic properties of congruences, Residue classes and complete residue systems.
2. Linear congruences, reduced residue systems and the Euler-Fermat theorem. Polynomial congruences modulo p. Lagrange's theorem.
3. Applications of Lagrange's theorem, Simultaneous linear congruences. The Chinese remainder theorem. Applications of the Chinese remainder theorem.

Unit – 5: Quadratic Residues and the Quadratic Reciprocity Law (15h)

1. Quadratic Residues, Legendre's symbol and its properties, Evaluation of (-1/p) and (2/p), Gauss lemma,
2. The Quadratic reciprocity law, Applications of the reciprocity law, The Jacobi Symbol.
3. Gauss sums and the quadratic reciprocity law, the reciprocity law for quadratic Gauss sums. Another proof of the quadratic reciprocity law.

Reference Books:

1. Tom M.Apostol, Introduction to Analytic Number theory, Springer International Student Edition.
2. David, M. Burton, Elementary Number Theory, 2nd Edition UBS Publishers.
3. Hardy & Wright, Number Theory, Oxford Univ, Press.
4. Dence, J. B & Dence T.P, Elements of the Theory of Numbers, Academic Press.
5. Niven , Zuckerman &Montgomery, Introduction to the Theory of Numbers.
6. Web resources suggested by the teacher and college librarian including reading material.

Co-Curricular Activities:

A) Mandatory:

1. For Teacher: Teacher shall train students in the following skills for 15 hours, by taking Relevant outside data (Field/Web).

1. Finding quotient and numbers from integer division and the method of solving congruences. Further problems related to the theory of quadratic residues.
2. Applications of Lagrange's theorem.
3. Applications of the Chinese remainder theorem.
4. Applications of the reciprocity law.

2.For Student: Fieldwork/Project work; Each student individually shall undertake Fieldwork/Project work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following**,** by choosing any one of the aspects.

1. Going through the web sources like Open Educational Resources and list out Applications of Lagrange's theorem, and make conclusions.(or)
2. Going through the web sources like Open Educational Resources and list out Applications of the Chinese remainder theorem and make conclusions.(or)
3. Going through the web sources like Open Educational Resource and list out Applications of the reciprocity law and make conclusions.

3. Max. Marks for Fieldwork/Project work Report: 05.

4. Suggested Format for Fieldwork/Project work Report:

Title page, Student Details, Index page,
Step wise work-done, Findings, Conclusions and Acknowledgements.

5. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to research organizations, Statistical Cells, Universities, ISI etc.
3. Invited lectures and presentations on related topics by experts in the specified area.

ADIKAVI NANNAYYA UNIVERSITY :: RAJAMAHENDRAVARAM

CBCS/ SEMESTER SYSTEM

(W. e. f 2020 – 21 Admitted Batch)

B. A./B. Sc. MATHEMATICS

COURSE – VI(A), NUMERICAL METHODS.

MATHEMATICS MODEL PAPER

Max. Marks: 75M **Time: 3Hrs**

SECTION – A

Answer any FIVE questions. Each question carries FIVE marks. **5 X 5 M = 25 M**

1) Find the function whose first difference is $9x^2 + 11x + 5$.

2) Find the missing term in the following table

x	0	1	2	3	4
y	1	1.5	2.2	3.1	4.6

3) If $f(x) = \frac{1}{x^2}$ then find the divided differences $f(a, b)$ and $f(a, b, c)$.

4) Using Gauss forward interpolation formula to find f(2.5) from the following table.

x	1	2	3	4
f(x)	1	8	27	64

5) Derive the derivative $\left(\frac{dy}{dx}\right)_{x = x_0}$ by using Newton's backward interpolation formula.

6) Find $\frac{dy}{dx}$ at $x = 0$, using the table

x	0	2	4	6	8	10
f(x)	0	12	248	1284	4080	9980

7) Evaluate the integral $\int_0^6 \frac{dx}{1+x}$ by using Simpson's $\frac{1}{3}$ rule.

8) Using Taylor's series method, solve the equation $\frac{dy}{dx} = x^2 + y^2$ for $x = 0.4$, given that

$y = 0$ when $x = 0$.

SECTION – B

Answer any ALL questions. Each question carries TEN marks. **5 X 10 M = 50 M**

9 a) State and Prove Newton's forward interpolation formula.

OR

9 b) Show that i) $\mu^2 = 1 + \frac{1}{4}\delta^2$ and ii) $1 + \mu^2 \delta^2 = \left(1 + \frac{1}{2}\delta^2\right)^2$

10 a) State and prove Bessel's formula.

OR

10 b) Using Lagrange's formula fit a polynomial to the following data and hence find f(1).

x	-1	0	2	3
f(x)	8	3	1	12

11 a) Derive the derivatives $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at $x = x_0$ by using Stirling's interpolation formula.

OR

11 b) Compute $f^1(4)$ and $f^1(5)$ from the following table

x	1	2	4	8	10
f(x)	0	1	5	21	27

12 a) State and prove General Quadrature Formula.

OR

12 b) Evaluate the integral $\int_0^6 \frac{dx}{1+x^3}$ dx by using Weddle's rule.

13 a) Use Runge – Kutta method to evaluate y (0.1) and y (0.2) given that $y^1 = x + y$, initial condition $y(0) = 1$.

OR

13 b) Given $\frac{dy}{dx} = x + y$ with initial condition $y(0) = 1$. Find y(0.05) and y(0.1), correct to 6 decimal places by using Euler's modified method.

ADIKAVI NANNAYA UNIVERSITY, RAJAMAHENDRAVARAM

B.A./B.Sc., FIFTH SEMESTER MATHEMATICS MODEL PAPER

7A: MATHEMATICAL SPECIAL FUNCTIONS

(w. e. f. 2020-21 admitted batch)

TIME: 3hrs MAX.MARKS :75

SECTION- A

Answer any **FIVE** questions. Each question carries 5 marks. 5 X 5 = 25 Marks

1. Evaluate $\int_0^2 \frac{x^2 dx}{\sqrt{(2-x)}}$
2. Show that $\Gamma\left(\frac{1}{2}+x\right)\ \Gamma\left(\frac{1}{2}-x\right) = \frac{\pi}{Cos\ \pi x}$
3. If the power series $\sum a_n x^n$ is such that $a_n \neq 0$ for all n and $\lim_{n\to\infty}\left|\frac{a_{n+1}}{a_n}\right| = \frac{1}{R}$ then prove that $\sum a_n x^n$ is convergent for $|x| < R$ and divergent for $|x| > R$
4. Prove that $H_n''(x) = 4n(n-1)\ H_{n-1}(x)$
5. Prove that $H_{2n}(0) = (-1)^n \frac{(2n)!}{n!}$
6. Prove that $P_n(-x) = (-1)^n P_n(x)$
7. Prove that $P_n'(1) = \frac{1}{2}n(n+1)$
8. Prove that $J_{-n}(x) = (-1)^n J_n(x)$ where n is a positive integer

SECTION -B

Answer any **FIVE** questions. Each question carries 10 marks. 5 X 10 = 50 Marks

9(a). Prove that $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$

OR

9(b). Prove that $2^n\Gamma\left(n+\frac{1}{2}\right) = 1.3.5 \ldots .(2n-1)\sqrt{\pi}$ *where n is a* positive integer

10(a). Solve $y' - y = 0$ by power series method

OR

10(b). Find the power series solution in powers of (x-1) of the initial value problem

$xy'' + y' + 2y = 0, y(1) = 1, y'(1) = 2.$

11(a). Prove that $H_n(x) = (-1)^n e^{x^2} \frac{d^n}{dx^n}\left(e^{-x^2}\right)$

OR

11(b). Prove that $2xH_n(x) = 2n\, H_{n-1}(x) + H_{n+1}(x)$

12(a). Prove that $(1 - 2xh + h^2)^{-1/2} = \sum_{n=0}^{\infty} h^n P_n(x)$

OR

12(b). $\int_{-1}^{1} P_m(x)\, P_n(x) dx = 0 \; if \; m \neq n$

13(a). $xJ_n^{'}(x) = n\, J_n(x) - x\, J_{n+1}(x)$

OR

13(b). Show that $J_{-1/2}(x) = \sqrt{\frac{2}{\pi x}}\, Cos\, x$

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MODEL QUESTION PAPER (Sem-End)

B.A./B.Sc. DEGREE EXAMINATIONS

Semester –V (Skill Enhancement Course-Elective)

Course 6B: MULTIPLE INTEGRALS & APPLICATION OF VECTOR CALICULUS

Time: 3Hrs **Max.Marks:75M**

SECTION - A

Answer any FIVE questions. **5 X 5M=25 M**

1. Evaluate $\int_0^a \int_0^b xy(x^2+y^2)dxdy$
2. Evaluate $\int_0^1 \int_{-1}^0 \int_{-1}^1 (x+y+1)dxdydz$
3. If $\bar{F}=(x+3y)\boldsymbol{i}+9y-2z)\boldsymbol{j}+(x+pz)\boldsymbol{k}$is a solenoidal find$p$.
4. Prove that $\Delta\times(\Delta\times\bar{A})=\nabla(\nabla.\bar{A})-\nabla^2\bar{A}$
5. Find the value of $\int(x+y^2)dx+(x-y^2)dy$, taken in the clockwise direction along the closed curve Cformed by $y^2=x$ and $y=x$between $(0,0)$ and $(0,1)$.

6. Evaluate$\int \bar{F}\,dr$, where $\bar{F}=x^2y^2\boldsymbol{i}+y\boldsymbol{j}$ and the curve C is $y^2=4x$ in the XY-plane from (0,0) to(4,4)
7. Show that $\int_S (ax\boldsymbol{i}+by\boldsymbol{j}+cz\boldsymbol{k}).\bar{n}ds=\frac{4\pi}{3}(a+b+c)$where S is the surface of the sphere $x^2+y^2+z^2=1$
8. By Stokes theorem evaluate $\int_C ydx+zdy+xdz$ where $C$is the curve of intersection of $x^2+y^2+z^2=a^2$ and $x+z=a$

SECTION - B

Answer ALL the questions. **5 X 10 M = 50 M**

9. a) Evaluate $\iint_S xydxdy$, where S is the region bounded by $xy=1, y=0, y=x, x=2$

(OR)

b) Change the order of integration and hence show that

$$\int_0^1 \int_0^{\sqrt{1-x^2}} \frac{dy}{(1+e^y)\sqrt{1-x^2-y^2}} = \frac{\pi}{2}\log\left[\frac{2e}{1+e}\right]$$

10. a) Using double integration find the valume of solid bounded by the coordinate plane $x=0, y=0, z=0$ and plane $x+y+z=1$

(OR)

b) Evaluate $\iiint xyzdxdydz$ taken over the cube bounded by the planes $x=0, y=0, z=0$ and $x=2, y=2, z=2$ in the first octant.

11. a) If $\bar{a}$ is a constant vector, prove that$curl\,\frac{\bar{a}\times\bar{r}}{r^3}=-\frac{\bar{a}}{r^3}+\frac{3\bar{r}}{r^5}(\bar{a}.\bar{r})$

(OR)

b) Prove that $grad(\bar{A}\bar{B}) = (\bar{B}.\nabla)\bar{A} + (\bar{A}.\nabla)\bar{B} + \bar{B} \times curl\bar{A} + \bar{A} \times curl\bar{B}$

12. a) Evaluate $\int_S \bar{F}\bar{N}\, ds$, where $\bar{F} = z\boldsymbol{i} + x\boldsymbol{j} - 3y^2z\boldsymbol{k}$ and$S$is the surface$x^2 + y^2 = 16$ included in the first octant between $z = 0$ and $z = 5$

(OR)

b) If $\bar{F} = 2xz\boldsymbol{i} - x\boldsymbol{j} + y^2\boldsymbol{k},$ evaluate$\int_V \bar{F}dv$where V is the region bounded by the surface $x = 0, x = 2, y = 0, y = 6, z = x^2, z = 4$

13. a) State and prove $Gauss's\ divergence\ theorem$

(OR)

b) Verify $Stokes\ theorem$ for $\bar{F} = -y^3\boldsymbol{i} + x^3\boldsymbol{j},$ where S is the circular disc $x^2 + y^2 \leq 1, z = 0$

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CBCS/ SEMESTER SYSTEM
(W. e. f 2020 – 21 Admitted Batch)
B. A./B. Sc. MATHEMATICS
COURSE – VII(B), INTEGRAL TRANSFORMS WITH APPLICATIONS

MATHEMATICS MODEL PAPER

Max. Marks: 75M **Time: 3Hrs**

SECTION – A

Answer any FIVE questions. Each question carries FIVE marks. **5 X 5 M = 25 M**

1. Find $L[f(t)]$, where $f(t) = \begin{cases} \sin\left(t - \frac{2\pi}{3}\right) & \text{if } t > \frac{2\pi}{3} \\ 1 & \text{if } t < \frac{2\pi}{3} \end{cases}$

2. . State and prove second shifting property of Laplace Transform.

3. . State Bessel's function and hence show that $L\left[J_0\left(a\sqrt{t}\right)\right] = \frac{e^{-\left(\frac{a^2}{s}\right)}}{s}$

4. Find $L^{-1}\left[\frac{p^2}{(p-3)^2}\right]$

5. Evaluate $\int_0^\infty \frac{\sin 2t}{t}\, dt$

6. Find $L^{-1}\left[\frac{3p+1}{(p-1)(p^2+1)}\right]$ by using partial fractions.

7. Solve $(D^2 - D - 2)y = 20\ \sin 2t$ if $y = 1, Dy = 2$ when $t = 0$ by the method of Laplace Transform.

8. Find the sine and cosine transform of the function $f(x) = x$.

SECTION – B

Answer any ALL questions. Each question carries TEN marks. **5 X 10 M = 50 M**

9. a) Evaluate $L[t^2\, e^{-2t} \cos t\,]$

OR

9. b) State and prove first shifting theorem and also find L[sin hat cos at]

10 . a) Show that $L\left(\frac{\sin t}{t}\right) = \tan^{-1}\left(\frac{1}{s}\right)$ and from this find the value of $L\left(\frac{\sin at}{t}\right)$.

Does $L\left(\frac{\cos at}{t}\right)$ exists ?

OR

10. b) Show that $\int_0^\infty t^3\, e^{-t} \sin t\, dt = 0$

11. a) State and prove Convolution theorem

OR

11. b) Evaluate $L^{-1}\left[\frac{2s+t}{(s+2)^2(s^2-1)}\right]$

12. a) Solve $(D^3 + 2D^2 - D - 1)y = 0$ given $y(0) = y^1(0) = 0$ and $y^{11}(0) = 6$ by the method of Laplace Transform.

OR

12. b) Solve the integral equation $f(t) = t + 2\int_0^t \cos(t-u)F(u)du = 0$

13. a) Find the finite cosine transform of $\left(1 - \frac{x}{\pi}\right)^2$ where $0 < x < \pi$.

OR

13. b) Find the fourier sine function of $\frac{e^{-ax}}{x}$ and hence deduce that

$$\int_0^\infty \left(\frac{e^{-ax} - e^{-bx}}{x}\right) \sin px\, dx = \tan^{-1}\left(\frac{p}{a}\right) - \tan^{-1}\left(\frac{p}{b}\right).$$

MODEL QUESTION PAPER (Sem-End)

B.A./B.Sc. DEGREE EXAMINATIONS

Semester –V (Skill Enhancement Course-Elective)

Course 6C: Partial Differential Equations and Fourier series

Time: 3Hrs **Max.Marks:75M**

SECTION - A

Answer any FIVE questions. **5 X 5M=25 M**

1. Solve $z = f(x^2 + y^2)$
2. Solve $(-a + x)p + (-b + y)q = (-c + z)$
3. Solve $-qy \log y = z \log y$
4. Solve using Charpit's method $pq = xz$
5. Find the complete integral of the partial differential equation $p^2q^2 + x^2y^2 = x^2q^2(x^2 + y^2)$
6. If $z = e^{(ax+by)} f(ax - by)$, then show that $a\left(\frac{\partial z}{\partial y}\right) + b\left(\frac{\partial z}{\partial x}\right) = 2abz$
7. Solve $zp = -x$
8. Dirichlet's conditions for Fourier series

SECTION - B

Answer ALL the questions. **5 X 10 M = 50 M**

9. a) Form a partial differential equation by eliminating the arbitrary function ϕ from $\phi(x^2 + y^2 + z^2, z^2 - 2xy) = 0$

(OR)

b) Solve the Cauchy's problem for $zp + q = 1$, where the initial data curve is $x_0 = \mu,\ y_0 = \mu,\ z_0 = \frac{\mu}{2} 0 \leq \mu \leq 1$

10. a) Solve $x(x^2 + 3y^2)p - y(3x^2 + y^2)q = 2z(y^2 - x^2)$

(OR)

b) Find the equation of the integral surface of the differential equation $2y(z - 3)p + (2x - z)q = y(2x - 3)$, which pass through the circle $z = 0, x^2 + y^2 = 2x$

11. a) Show that the equation $z = px + qy$ is compatible with any equation $f(x, y, z, p, q) = 0$ which is homogeneous equation in x, y, z

(OR)

b) Find the complete integral of $(x^2 + y^2)(p^2 + q^2) = 1$

12. a) Find complete integral of $2p_1x_1x_3 + 3p_2x_3{}^2 + p_2{}^2p_3 = 0$

(OR)

b) Solve $p^2 + q^2 = k^2$, by Jacobi's method

13. a) Find the Fourier series for $f(x)$ define by $f(x) = x \; for \; 0 < x < 1$ and $f(x) = 1 - \; x \; for \; 1 < x < 2$. Deduce $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$

(OR)

b) Apply Parsvel's identity to the function $f(x) = x,\ -\pi \leq x \leq \pi$ and deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots + \frac{1}{n^2} + \cdots$

ADIKAVI NANNAYA UNIVERSITY, RAJAMAHENDRAVARAM

B.A./B.Sc., FIFTH SEMESTER MATHEMATICS MODEL PAPER

7C: NUMBER THEORY

(w. e. f. 2020-21 admitted batch)

TIME: 3hrs MAX.MARKS :75

SECTION- A

Answer any **FIVE** questions. Each question carries 5 marks. 5 X 5 = 25 Marks

1. If a prime p divides ab then $p/a \ or \ p/b$
2. If $n \geq 1$ then log n = $\sum_{d/n} \wedge (d)$
3. If both g and f *g are multiplicative then f is also multiplicative
4. Show that for $x \geq 1$, $\sum_{n \leq x} \mu(n) \left[\frac{x}{n}\right] = 1$
5. Show that for $x \geq 2$, $\sum_{p \leq x} \left[\frac{x}{p}\right] \log p = x \log x + O(x)$ where the sum is extended over all primes $\leq$ x.
6. For any integer a and any prime p then Prove that $a^p \equiv a \ (mod \ p)$
7. If (a, m) = 1 then prove that the linear congruence ax ≡ b (mod m) has exactly one solution.
8. For every odd prime p, $(s/p) = (-1)^{p^2-1/8} = \begin{cases} 1 \ if \ p \equiv \pm 1 (mod 8) \\ -1 \ if \ p \equiv \pm 3 (mod \ 8) \end{cases}$

SECTION-B

Answer any **FIVE** questions. Each question carries 10 marks. 5 X 10 = 50 Marks

9(a). State and prove fundamental theorem of arithmetic.

OR

9(b). State and prove the division algorithm.

10(a). If $n \geq 1$ then $\phi(n) = \sum_{d/n} \mu(d) \frac{n}{d}$

OR

10(b). State and prove Mobius inversion formula

11(a). State and prove Eulers summation formula

OR

11(b). For $x > 1$, $\sum_{n \le x} \Phi(n) = \frac{3}{\Pi^2} x^2 + O(x \log x)$

12(a). State and prove Lagrange's theorem

OR

12(b). State and prove Chinese remainder theorem

13(a). State and prove Gauss lemma

OR

13(b). State and prove Quadratic Reciprocal Law

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