DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(Autonomous)
College with Potential for Excellence
Linguistic Minority Institution. Affiliated to University of Madras

POST GRADUATE AND RESEARCH
DEPARTMENT OF MATHEMATICS

B.Sc. Mathematics (MPC & MAN)

CURRICULUM AND SCHEME OF EXAMINATIONS
Choice Based Credit System (CBCS)
&
Outcome Based Education (OBE)

(with Effect from the Academic Year 2024-2025)

1. PREAMBLE

The curriculum of B.Sc. Mathematics is structured in a way that the students acquire in-depth knowledgeto perceive the principles of the core. Basics in Algebra, Calculus , Analytical Geometry , Differential Equations and Transform Techniques are covered exclusively to prepare the students to proceed to the next level of Higher Mathematics of Linear Algebra, Real and Complex Analysis, Mechanics. A list of varied electives namely, Operations Research, Graph Theory, Number Theory, Mathematical Modelling, Programming with Python are furnished to bridge between the Main and Applied Mathematics. The comprehensive curriculum design yields an excellent career opportunity in Research, Education, Public and Private Sectors, Business sectors, Banking, IT Industries and in every domain of contemporaries.

2. PROGRAM LEARNING OUTCOMES

The comprehensive course outline enables the students to enhance Computational skills and Mathematical reasoning. The program develops the ability to think critically, logically and analytically thereby preparing the students to enhanced career opportunities in Industries, Commerce, Education andResearch.

NATURE AND EXTENT OF BACHELOR'S DEGREE PROGRAMME

Mathematics is the culmination of in-depth of knowledge of Algebra, Calculus, Differential equations and several other branches of Mathematics. This also leads to selected areas like Computer science and Statistics. Mathematics is a diverse discipline that deals with data, measurement and observations from science, with inference, deduction and proof and with mathematical models of naturalphenomena of human behaviour and of social systems.

AIMS OF BACHELOR'S DEGREE PROGRAMME IN MATHEMATICS

The overall aim of B.Sc. Mathematics is to

- develop broad and balanced knowledge and understanding of definitions,concepts,principles and theorems.
- enhance the ability of learners to apply the knowledge and skills acquired by themduring the programme to solve specific theoretical and applied problems in mathematics.
- provide students/learners sufficient knowledge and skills enabling them toundertakefurther studies in mathematics and its allied areas on multiple disciplines concerned with mathematics.

GRADUATE ATTRIBUTES IN MATHEMATICS

The graduate attributes in mathematics are mentioned in the expected course learning outcomes of each course which provides critical thinking, analytical reasoning, problem solving and research related skills etc,.

POST GRADUATE AND RESEARCH DEPARTMENT OF MATHEMATICS

VISION

- To promote and support a comprehensive, innovative and dynamic learning environment
- To assist students in acquiring a conceptual understanding of the nature and structure of mathematics its processes and applications.

MISSION

- To establish an atmosphere of creative endeavor that supports interdisciplinary collaborations, innovative projects, significant research and informal discussions that mutually benefit students, faculty and community at large.

PROGRAM OUTCOME FOR UNDER GRADUATE

At the end of the programme the student will be able :

PO1	To participate in various types of employment, development activities and public discourses particularly in response to the needs of the community one serves
PO2	To understand the need and have the competencies to support local, regional and national development
PO3	To develop critical and analytical thinking
PO4	To develop conceptual understanding , problem solving and application of skills
PO5	To provoke entrepreneurship among the students along with strong ethics and communication skills
PO6	To develop a questioning mind in diverse environments for better outcomes
PO7	To engage in lifelong learning and enduring proficient progress

Program Specific Outcomes (PSO)

At the end of the program, the student will be able to:

PSO	Program Specific Outcomes (PSO)
PSO1	**Mathematical Thinking:** Acquire abstract mathematical thinking and the capability of developing ideas based on them.
PSO2	**Career:** Practice mathematical tasks, tools, representation and methods for industry and entrepreneurial pursuit.
PSO3	**Creativity:** Develop quest for mathematics and prepare for higher learning.

Curriculum and scheme of Examination under CBCS and OBE
(Applicable to the students admitted during the Academic Year 2024-2025 and Onwards)

FIRST SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - I	Language Paper -I	5	3	50	50	100
Part - II	English Paper -I	4	3	50	50	100
Part - III	Core Paper-I: Algebra and Trigonometry	5	4	50	50	100
	Core Paper-II: Differential Calculus	4	4	50	50	100
	Allied Paper- I: Physics – I/Financial Accounting	9	5	50	50	100
Part - IV	Basic Tamil/Adv. Tamil/Non Major Elective -I	2	2	50	50	100
	Soft Skills -I	2	3	50	50	100

SECOND SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - I	Language Paper -II	5	3	50	50	100
Part - II	English Paper -II	5	3	50	50	100
Part - III	Core Paper-III: Analytical Geometry	4	4	50	50	100
	Core Paper-IV: Integral Calculus and Vector Analysis	5	4	50	50	100
	Allied Paper- II : Physics – II/Cost and Management Accounting	9	5	50	50	100
Part - IV	Basic Tamil/Adv. Tamil/Non Major Elective -II	2	2	50	50	100
	Soft Skills -II	2	3	50	50	100

THIRD SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - I	Language Paper -III	5	3	50	50	100
Part - II	English Paper -III	5	3	50	50	100
Part - III	Core Paper-V: Differential Equations	5	4	50	50	100
	Core Paper-VI: Elementary Number Theory	4	4	50	50	100
	Allied Paper- III : Chemistry – I/ Probability and Statistics-I	9	5	50	50	100
Part - IV	Environmental Studies	1		EXAM IN THE IV SEMESTER		
	Soft Skills -III	2	3	50	50	100
	Extra disciplinary		1			

FOURTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - I	Language Paper -IV	5	3	50	50	100
Part - II	English Paper -IV	5	3	50	50	100
Part - III	Core Paper-VII: Integral Transform	4	4	50	50	100
	Core Paper-VIII: Discrete Mathematics	5	4	50	50	100
	Allied Paper- IV : Chemistry – II/ Probability and Statistics-II	9	5	50	50	100
Part - IV				50	50	
	Environmental Studies	1	2	50	50	100
	Soft Skills -IV	2	3	50	50	100
	Value added course					
	Extra disciplinary		1			

FIFTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - III	Core Paper-IX: Algebraic Structures	6	4	50	60	100
	Core Paper -X: Real Analysis-I	6	4	50	50	100
	Core Paper-XI: Mechanics	6	4	50	50	100
	Core Paper – XII: Operations Research	6	4	50	50	100
	Elective Paper -I: Programming in Python With Practicals -I (Theory) **(Skill Enhancement Course)**	4	3	50	50	100
	Practical Paper 1: Programming in Python Lab- I	2	2	50	50	100
Part - IV						
	Value Education		2	50	50	100
	Internship		1			
	Value added course					

SIXTH SEMESTER

Course Content	Name of the Course	Ins. Hrs	Credits	Int. Marks	Ext.Marks	Total
Part - III	Core Paper-XIII: Linear Algebra	6	4	50	60	100
	Core Paper -XIV: Real Analysis-II	6	4	50	50	100
	Core Paper-XV: Complex Analysis	6	4	50	50	100
	Elective Paper -II: Programming in Python With Practicals - II (Theory) **(Skill Enhancement Course)**	4	3	50	50	100
	Practical Paper – II :Programming in Python Lab -II	2	2	50	50	100
	Elective Paper -III: Graph Theory and its Applications **(Skill Enhancement Course)**	5	3	50	50	100
Part – V	Extension Activity		1			
	Project	1	1			

List of Allied Papers

Group -A

- Probability and Statistics - I
- Numerical Methods - I

Group -B

- Probability and Statistics- II
- Numerical Methods- II

List of Elective Subjects

Group – A

1. Programming In Python With Practicals - I
2. Mathematical Modeling.
3. Special Functions
4. Machine learning with R

Group – B

1. Graph Theory and Its Applications
2.. Mathematical Statistics with R
3. Programming In Python With Practicals - II
4. Tropical Linear Algebra.

Extra Disciplinary Course:

- Predictive Modelling with R (practicals)
- Numerical Methods
- Mathematics for competitive examinations & general studies

Value Added Course:

- Data Analytics
- LateX
- Neural Networks and Algorithm
- Aptitude training

Tally Table:

Subject	No. of Subjects	Total Marks	credits
Core – Theory Papers	15	1500	60
Elective Papers(Theory)	3	300	9
Practical Paper	2	200	4
Allied Papers	4	400	20
Language	4	400	12
English	4	400	12
Soft skills	4	400	12
Non Major electives/ Basic Tamil	2	200	4
Environmental Science	1	100	2
Value Education	1	100	2
Internship	1		1
Project	1		1
Value added course	2		-
Extension Activity	1	100	1
Extra disciplinary paper	2		2
Grand Total		**4100**	**142**

- A field trip will be undertaken in second year.
- **Industrial Visit** relevant to the course will be undertaken in final year.

Components of Continuous Internal Assessment

<table>
<tr><th colspan="2">Components</th><th>Marks</th><th>Total</th></tr>
<tr><td colspan="4">Theory</td></tr>
<tr><td>CIA I</td><td>50</td><td rowspan="2">30</td><td rowspan="4">50</td></tr>
<tr><td>CIA II</td><td>50</td></tr>
<tr><td colspan="2">Generic Activity</td><td>15</td></tr>
<tr><td colspan="2">Attendance</td><td>5</td></tr>
</table>

Question paper pattern for End Semester Examinations

Knowledge Level	**Section**	Marks
K1	**Section A** Answer all the 10 Questions.	10x2 = 20 Marks
K2	**Section B** Answer all the 5 Questions (Each unit 2 questionseither or pattern)	5x7 =35Marks
K3 and K4	**Section C** Q.No.16 is compulsory. Remaining two questions either or pattern.	3x15 = 45 Marks
	Total	**100 Marks**

❖ Question Paper pattern for Continuous Assessment Test, Modes of assessment for

Generic activityand Value added course :

CIA Tests -I	Multiple choice questions
CIA- II	Descriptive: Section A: 7 x 2 = 14 (Answer any 7 out of 10) Section B: 3 x 7 = 21 (Answer any 3 out of 5) Section C : 1 x 15 = 15 (Answer any 1 out of 3) Total - 50 marks
Generic Activity	Conducting Seminars or Micro projects or Group discussion or Problem solving or Assignments.
Project	Internal Viva-voce
Extra disciplinary	Conducting Group discussion or Paper Presentation orSeminars or viva-voce.
Value Added Course	Conducting Group discussion or Paper Presentation or Seminars or viva-voce.

Title of the Course		ALGEBRA AND TRIGONOMETRY					
Paper Number		I					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	I				

Objectives of the Course	
	• Basic ideas on the Theory of Equations, Matrices and Number Theory. • Knowledge to find expansions of trigonometry functions, solve theoretical and applied problems.
Course Outline	**Unit 1** Reciprocal equations – Standard form-Increasing or Decreasing the roots of the given equation -Removal of terms-Approximate solutions of roots of polynomials by Horner's method-Related Problems. **Chapter 6: Sections: 16, 16.1,17, 19,30**
	Unit 2 Summation of Series : Binomial- Exponential -Logarithmic series (Theorems without proof)-Related Problems. **Chapter -3: Sections:10 Chapter-4:Sections: 3 to 7**
	Unit 3 Characteristic equation- Eigen values & EigenVectors-Similar matrices- Cayley - Hamilton Theorem(Statement only)-Finding powers of square matrix-Inverse of a square matrix up to order 3-Diagonalization of square matrices-Related Problems. **Chapter 2: Sections:16,16.1 to 16.4**
	Unit 4 Expansions of sin nθ, cos nθ in powers of sin θ, cos θ – Expansions of tan nθ interms of tan θ- Expansions of $\cos^n \theta$, $\sin^n\theta$, $\cos^m \theta\sin^n \theta$- Expansions of tan $(\theta1+\theta2 +...+\theta n)$ - Expansions of sin θ, cos θ and tan θ in terms of θ –Related Problems. **Chapter 2:Sections: 2.1, 2.1.1, 2.1.2** **Chapter 3: Sections:3.1,3.1.1,3.2.1,3.4,3.4.1 to 3.4.3**
	Unit 5 Hyperbolic functions-Relation between circular and hyperbolic functions- Formulas in hyperbolicfunctions – Inverse hyperbolic functions-Logarithm of complex quantities, Summation of Trigonometric series – Related problems. **Chapter 4: Sections: 4.1 to 4.7.** **Chapter 5:Sections: 5.1 to 5.3** **Chapter 6:Sections: 6.1 to 6.6**

Contents and treatment as in	1. Algebra,Volume I by T. K. ManicavachagamPillay, T.Natarajan,. K.S.Ganapathy,Viswanathan Publication 2007.Unit – 1 and 2. 2. Algebra, Volume II byT. K. ManicavachagomPillay ,T.Natarajan ,K.S.Ganapathy, ViswanathanPublication 2008.Unit – 3. 3. Trigonometry by P. Duraipandian and KayalalPachaiyappa, Muhil Publishers,Unit-4,Unit-5
Reference Books	1. W.S. Burnstine and A.W. Panton, Theory of equations 2. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007 3. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., PearsonEducation, Delhi, 2005 4. C. V. Durell and A. Robson, Advanced Trigonometry, Courier Corporation, 2003 5.J. Stewart, L. Redlin, and S. Watson, Algebra and Trigonometry, Cengage Learning, 2012. 6. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010.
e-Resources	1. http://mathworld.wolfram.com 2. http://www.themathpage.com/ 3. http://mathworld.wolfram.com 4. http://ocw.mit.edu/courses/mathematics/

Course Outcomes: At the end of the course, the Student will be able to

CO1	Classify and Solve reciprocal equations
CO2	Find the sum of binomial, exponential and logarithmic series
CO3	Find Eigen values, eigen vectors, verify Cayley – Hamilton theorem and diagonalize a given matrix
CO4	Expand the powers and multiples of trigonometric functions in terms of sine and cosine
CO5	Determine relationship between circular and hyperbolic functions and the summation of trigonometric series

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	2	2	3	2	1
CO2	3	3	2	2	1	2	2	2	3	2
CO3	2	2	3	2	3	2	2	1	2	2
CO4	3	2	1	2	2	2	1	3	2	2
CO5	3	2	3	2	2	2	1	3	2	2

1 - Low 2 – Medium 3 – High

Title of the Course		DIFFERENTIAL CALCULUS					
Paper Number		II					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	I				

Course Objectives

- To develop the ability to use Leibnitz Rule
- To know about the method to find the maxima and minima
- To develop the skills of the students in the area of Curvature
- To learn methods and techniques of finding asymptotes.

CONTENTS OF MODULE
UNIT – I : Successive differentiation - n th derivative- standard results – Trigonometrical transformation – formation of equations using derivatives - Leibnitz's theorem and its applications Chapter 3 section 1.1 to 1.6, 2.1 and 2.2
UNIT-II : Total differential of a function – special cases – implicit functions - partial derivatives of a function of two functions - Maxima and Minima of functions of two variables- Lagrange's method of undetermined multipliers. Chapter 8 : Section 1.3 to 1.5 and 1.7, Section 4, 4.1 and 5.
UNIT– III: Envelopes – method of finding envelopes – Curvature- circle, radius and centre of curvature- Cartesian formula for radius of curvature – coordinates of the centre of curvature – evolute-and involute - radius ofcurvature and centre of curvature in polar coordinates – p-r equation Chapter 10 Section 1.1 to 1.4 and Section 2.1 to 2.7
UNIT-IV: Polar coordinates - angle between the radius vector and the tangent – slope of the tangent in the polar coordinates – the angle of intersection of two curves in polar coordinates- polar sub tangent and polarsub normal – the length of arc in polar coordinates. Chapter 9 Section 4.1 to 4.6
UNIT-V: Definition-Asymptotes parallel to the axes – special cases – another method for finding asymptotes -asymptotes by inspection – intersection of a curve with an asymptote. Chapter 11 - Section 1 to 7.

Recommended Text Book :

1. "Calculus", Volume - 1 by S. Narayanan and T.K. Manicavachagompillay S.Viswanathan publishers – 2006.

Reference Books:

1. Calculus , Dr. P.R. Vittal &Dr. V. Malini, Margham Publications, Chennai.
2. Calculus by Thomas and Fenny, Pearson Publication. Calculus by Stewart
3. Introduction to Calculus and Analysis ,R. Courant and F. John, (Volumes I & II), Springer- Verlag, New York, Inc., 1989.
4. Calculus T. Apostol Volume I and II.
5. Calculus and mathematical analysis, S. Goldberg.

Website and e-Learning Source

https://nptel.ac.in https://mathhelp.com

Course Outcomes: At the end of the course, the Student will be able to

CO1	Evaluate the nth derivative Using Leibnitz Rule
CO2	Finding the maxima and minima for the functions of two variables
CO3	Calculate the Envelope, Evolute, radius of curvature and circle of curvature
CO4	Finding the angle between radius vector and tangent.
CO5	Calculate the asymptotes of the curve

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**1**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**2**
CO3	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**
CO4	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**3**	**2**	**2**
CO5	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**3**	**2**	**2**

1 - Low 2 – Medium 3 – High

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ANALYTICAL GEOMETRY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">III</td></tr>
<tr><td colspan="2" rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="9">Objectives of the Course
Necessary skills to analyze characteristics and properties of two-and three-dimensional geometric shapes.
To present mathematical arguments about geometric relationships.
To solve real world problems on geometry and its applications</td></tr>
<tr><td rowspan="5">Course Outline</td><td colspan="8">UNIT-I: Polar and pole, conjugate points and conjugate lines-diameters – conjugate diameters of an ellipse - semi diameters-conjugate diameters of hyperbola.
Chapter 7: Sections: 7.2, 7.3 , Chapter 8 Section 8.2 – 8.5.</td></tr>
<tr><td colspan="8">UNIT-II: Polar coordinates: General polar equation of straight line – Polar equation of a circle given a diameter, Equation of a straight line, circle, conic – Equation of chord, tangent, normal. Equations of theasymptotes of a hyperbola.
Chapter 10 : Sections : 10.1 – 10.8.</td></tr>
<tr><td colspan="8">UNIT-III: The plane – Transformation to the normal form – Determination of a plane under given conditions - System of Planes – Two sides of a plane - Length of the perpendicular from a point to a plane – Joint equation of two planes – Orthogonal projection on a plane.
Chapter 2: Sections : 2.3 –2.9.</td></tr>
<tr><td colspan="8">UNIT-IV: Representation of line – line and a plane - co-planar lines – constants in the equations of a straight line – the shortest distance between two skew lines- Length of the perpendicular from a point to aline - intersection of three planes.
Chapter 3: Sections: 3.1 to 3.8.</td></tr>
<tr><td colspan="8">UNIT-V: Equation of a sphere – Definition – the sphere through four given points - Section of a sphere by a plane - equation of a circle - tangent plane - angle of intersection of two spheres- condition for the orthogonality of two spheres - radical plane.
Chapter 6: Sections: 6.1 – 6.8.</td></tr>
<tr><td>Contents and treatment as in</td><td colspan="8">1. Analytical Geometry of 2D by P.Duraipandian- Muhil Publishers for Unit 1 and Unit 2
2. Analytical Solid Geometry of 3D by Shanthi Narayan and Dr.P.K. Mittal- S.Chand & Co. Pvt.Ltd.- for Unit 3 to Unit 5</td></tr>
</table>

Reference Books	1. Calculus and Analytical Geometry, G.B. Thomas and R. L. Finny, Pearson Publication, 9th Edition, 2010. 2. Analytic Geometry with Calculus, Robert C. Yates, Prentice Hall, Inc., New York, 1961. 3. Algebra and Trigonometry with Analytic Geometry, Earl W. Swokowski and Jeffery A. Cole, Twelfth Edition, Brooks/Cole, Cengage Learning, CA, USA, 2010. 4. Analytical Geometry of Three Dimensions, William H. McCrea, Dover Publications, Inc, New York, 2006. 5. Calculus and Analytic Geometry,John F. Randelph, WadsworthPublishing Company, CA, USA, 1969. 6.Analytic Geometry and Calculus with Vectors, Ralph Palmer Agnew, McGraw-Hill Book Company, Inc. New York, 1962.
e-Resources	1. https://nptel.ac.in 2. https://www.mathhelp.com/

Course Outcomes: At the end of the course, the Student will be able to

CO1	Find pole, polar for conics, diameters, conjugate diameters for ellipse and hyperbola
CO2	Find the polar equations of straight line and circle, equations of chord, tangent and normal and to find theasymptotes of hyperbola
CO3	Explain in detail the system of Planes
CO4	Explain in detail the system of Straight lines
CO5	Explain in detail the system of Spheres

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**1**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**2**
CO3	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**
CO4	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**3**	**2**	**2**
CO5	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**3**	**2**	**2**

1 - Low 2 – Medium 3 – High

Title of the Course		INTEGRAL CALCULUS AND VECTOR ANALYSIS					
Paper Number		IV					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	II				

Course Objectives

- To develop the ability to use Reduction formula
- To know about the method to find the Volume
- To develop the skills of the students in the Indefinite Integral.
- To learn methods and techniques of solving line and surface Integral.

CONTENTS OF MODULE
UNIT – I: Reduction formulae– Types, $\int x^n e^{ax} dx$, $\int x^n cosaxdx$, $\int x^n sinaxdx$, $\int cos^n xdx$, $\int sin^n xdx$, $\int sin^m x cos^n xdx$, $\int tan^n xdx$, $\int cot^n xdx$, $\int$, $\int cosec^n xd$, $\int x^n (\log x)^m dx$ -Bernoulli'sformula. **Chapter 1 Section 13, 13.1 to 13.10,14,15.1**.
UNIT-II : Multiple Integrals- definition of the double integrals- evaluation of the double integrals- double integrals in polar coordinates – triple integrals – change of variables – Jacobians-Propeties without proof. **Chapter 5 Section 1, 2.1, 2.2, 3.1, 4** **Chapter 6 Section 1.1, 1.2**
UNIT– III: Beta and Gamma functions - infinite integral – definitions – recurrence formula of Gamma functions -properties of Gamma-functions - relation between Beta and Gamma functions. Evaluation of double and triple integrals using Beta gamma functions. **Chapter 7 Section 2.1,2.2, 2.3, 3,4,5**
UNIT-IV: Introduction - directional derivative- Gradient- divergence- curl- Laplacian Differential Operator. **Chapter 2 Sections 2.1 - 2.13.**
UNIT-V: Line, surface and volume integrals - Integral Theorems - Gauss, Greens and Stokes (Without proof) –Problems. **Chapter 3 Sections 3.1 to 3.6** **Chapter 4 Sections 4.1 to 4.5.**

Recommended Text Book :

1. "Calculus",Vol-II by S.Narayanan and T.K.Manicavachagampillay S. Viswanathanpublishers– 2007 for Unit 1 , Unit 2 , Unit 3.

2. "Vector Analysis" by P.Duraipandian and Kayalal Pachaiyappa, S.ChandFor Unit 4,Unit 5.

Reference Books:

1. Integral Calculus and differential equations : Dipak Chatterjee (TATA McGrawHill Publishing companyLtd.).
2. Vector Algebra and Analysis by Narayanan and T.K.Manickvachagam PillayS Viswanathan Publishers.
3. Vector Analysis: Murray Spiegel (Schaum Publishing Company, NewYork).

Website and e-Learning Source https://nptel.ac.in https://mathhelp.com

Course Outcomes:

At the end of the course, the Student will be able to

CO1	Evaluate the Integral using Reduction formula
CO2	Calculate Area and Volume using double and triple Integral
CO3	Evaluate the Indefinite Integral using the properties of Beta and Gamma function.
CO4	Calculate directional derivatives, Curl, divergence.
CO5	Solve Line and Surface Integral using Greens, stokes and Gauss theorem

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**1**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**2**
CO3	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**2**
CO4	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**2**	**2**
CO5	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**2**

1 Low 2 – Medium 3 – High

Title of the Course		DIFFERENTIAL EQUATIONS					
Paper Number		V					
Category	Core	Year	II	Credits	4	Course Code	
		Semester	III				

Course objectives

- To solve first order Ordinary differential equations
- To evaluate particular integrals of special forms
- To solve non homogeneous simultaneous linear differential equations
- To compute complete, singular and general integrals of partial differential equations
- To apply Charpits method

Course Outline	**Unit I: Ordinary Differential Equations:** Concept of existence and uniqueness . Variable separable-Homogeneous Equation-Non-Homogeneous Equations of first degree in x and y-Linear Equation-Bernoulli's Equation-Exact differential equations. Chapter 2: Section 1 to 6.
	Unit II: Equation of first order but not of higher degree: Equation solvable for dy/dx- Equation solvable for y- Equation solvable for x- Clairauts form- Linear Equations with constant coefficients-Particular integrals $e^{ax}, \sin ax, \cos ax, x^m, Ve^{ax}$ $where\ V\ is \sin ax\ \ or \cos ax\ \ or\ x^m$. Chapter 4: Section 1, 2.1, 2.2, 3.1, Chapter 5: Section 4.
	Unit III: Simultaneous linear differential equations- Linear Equations of the Second Order -Complete solution in terms of a known integrals- Reduction to the Normal form- Change of the Independent Variable - Method of Variation of Parameters(constant coefficients). Chapter 6: Section- 6 ,Chapter 8:Section- 1,2,3,4.
	Unit IV: Partial differential equation: Formation of PDE by Eliminating arbitrary constants and arbitrary functions-complete integral-singular integral-General integral- Lagrange's Linear Equations Pp+Qq=R. Chapter 12: Section- 1, 2, 3.1, 3.2, 4.
	Unit V: Special methods - Standard forms - Charpit's Methods - Related problems Chapter 12: Section-5.1, 5.2, 5.3, 5.4, 6.

Recommended Text:

Differential Equations and its applications", by S.Narayanan, T.K.Manikavachagam Pillay –- S.Viswanathan (Printers and Publishers) Pvt. Ltd(2006).

ReferenceBooks

1. Introductory course in Differential Equations, D.A. Murray, Orientand Longman
2. Elementary Treaties on Differential Equations and their applications, H.T. H. Piaggio, C.B.S Publisher &Distributors,Delhi,1985.
3. Calculus and Analysis, Horst R. Beyer, Wiley, 2010.
4. Differential Equations and their Applications, B r a u n , M. (3rd Edn.), Springer- Verlag, New York.1983.
5. Linear Partial Differential Equations for Scientists and Engineers Tyn Myint-U and Lognath Debnath. (4th Edn.) Birhauser, Berlin.2007.
6. Elementary Differential Equations and Boundary Value Problems, Boyce, W.E. and R.C. DiPrima. (7thEdn.) John Wiley and Sons, Inc.,New York. 2001.
7. Ordinary and Partial Differential Equations, Sundrapandian, V. Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2013

Website and e-Learning Source https://nptel.ac.in https://www.mathhelp.com/

Course Outcomes: At the end of the course, students will be able to

CO1	Solve linear differential equation and Demonstrate Bernoulli's equation and exactness of first order differential equations
CO2	Exhibit Clairauts form and solve linear differential equations with constant coefficients
CO3	Apply variation of parameter method to solve second order differential equations
CO4	Demonstrate Partial differential equations and its solutions
CO5	Implement Charpit's method

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	2	2	2	2	2
CO2	2	3	2	2	2	1	2	1	2	2
CO3	2	2	1	1	1	2	2	2	3	2
CO4	1	2	2	2	2	2	3	3	2	3
CO5	3	2	3	3	3	2	2	2	2	2
1 Low 2 – Medium 3 – High										

Title of the Course		ELEMENTARY NUMBER THEORY					
Paper Number		VI					
Category	Core	Year	II	Credits	4	Course Code	
		Semester	III				

Course objectives

- To explain the application of divisibility, congruences and its applications in number theory from an algebraic view point.
- To demonstrate quadratic residues, describe mobius inversion formula and solving simultaneous linear equations.

CONTENTS OF MODULE
Unit I : Introduction-Divisibility-Primes-The Binomial theorem
Unit II: Congruences, Solution of Congruences,Chinese Remainder Theorem-Primitive roots and Power residue
Unit III: Quadratic Residue,Quadratic reciprocity,The Jacobi Symbol
Unit IV: Greatest Integer Function,Arithmetic function,The Mobius Inversion formula
Unit V: The equation ax+by=c,Simultaneous Linear Equation,Pythagorean Triangle

Contents and treatment as in : "An Introduction to the Theory of Numbers (Vth edition)",by Ivan Niven, Herbert S.Zuckarman and Hugh L.Montgometry John Wiley&Sons , Inc.2001.

Chapter 1	**Sections 1.1 to 1.4**
Chapter 2	**Sections 2.1-2.3,2.8**
Chapter 3	**Sections 3.1 to 3.3**
Chapter 4	**Sections 4.1, 4.2 and 4.3**
Chapter 5	**Sections 5.1 to 5.3**

Reference Books:

1.Elementary theory of numbers,cy.Hsiung, Allied publishers,1995
2.Elementary Number Theory,Allyn and Bacon Inc.,Boston,1980
3.Intoduction to Analytic Number Theory, Tom.M.Apostol,Narosa Publishing Houses, New Delhi,1989

e-Resources:

1.https://nptel.ac.in
2.https://mathonline.wikidot.com

Course outcomes: At the end of the course, students will be able to

CO1	Illustrate divisibility, primes and the binomial theorem
CO2	Judge the solution of congruences using Chinese remainder theorem and explain primitive roots and residues.
CO3	Develop the importance of quadratic residues and reciprocity to apply in quadratic residues and reciprocity.
CO4	Compare greatest integer function and arithmetic function and develop it to mobius inversion formula.
CO5	Examine simultaneous linear equations and formulate it to pythogorean triangles.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**3**
CO2	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**3**
CO3	**3**	**3**	**2**	**1**	**2**	**3**	**3**	**1**	**3**	**3**
CO4	**3**	**2**	**3**	**1**	**2**	**3**	**3**	**3**	**2**	**3**
CO5	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**3**

1 Low 2 – Medium 3 – High

Title of the Course		PROBABILITY AND STATISTICS – I					
Paper Number		III					
Category	Allied	Year	II	Credits	5	Course Code	
		Semester	III				

Course Objectives

Students will acquire knowledge of

- The laws of Probability and Baye's theorem.
- Measures of Location, Dispersion, Correlation and Regression
- The Discrete and Continuous Probability Distribution

COs	CONTENTS OF MODULE
CO1	**UNIT-I:** Concept of sample space – Events – Definition of Probability (classical, Statistical & Axiomatic) – Addition and Multiplication laws of Probability– Independence – Conditional Probability – Baye's theorem - Simple Problems Chapter - 4: Sections - 4.3,4.3.1,4.5,4.5.1,4.5.2,4.5.3,4.6.1,4.6.2,4.7,4.9.
CO2	**UNIT- II:** Random Variables (Discrete and Continuous) Distribution function- Expected values and Moments- Moment generating function – cumulants- Examples Chapter - 5: Sections - 5.1,5.2,5.3,5.4,5.4.1,5.4.3 Chapter - 6: Sections - 6.1,6.7,6.9,6.10.
CO3	**UNIT–III:** Characteristic function- Uniqueness and Inversion theorems (Statements and applications only)- Chebychev's Inequality – Simple Problems. Convergence in probability, Weak Law of large numbers with numerical examples. Chapter - 6: Sections - 6.11,6.12.
CO4	**UNIT-IV:** Concepts of bivariate distributions- Correlation and Regression- Linear Prediction- Rank Correlation coefficient, Intra class correlation coefficient, Concepts of partial and multiple correlation coefficients- Simple problems. Chapter - 10: Sections - 10.1 - 10.7.4.
CO5	**UNIT-V:** Standard Distributions – Bernoulli Distribution, Binomial- Poisson- Normal- Uniform distributions- Geometric- Exponential- Gamma -Beta distributions- Inter relationship between distributions. Chapter - 7: Sections - 7.1,7.2,7.3.1. Chapter - 8: Sections - 8.1- 8.6.

Contents and treatment as in	Elements of Mathematical Statistics, by S.C.Gupta &V.K.Kapoor, Sultan Chand & Sons, New Delhi.
Reference Books	1. Hogg R.V. & Craig A.T. (1988) : Introduction to Mathematical Statistics, McMillan. 2. Mood A.M. &Graybill F.A. &Boes D.G. (1974): Introductionto theory of Statistics,McGraw Hill. 3. Snedecor G.W. & Cochran W.G(1967) : Statistical Methods, Oxford and IBH.
e-Resources:	1. https://nptel.ac.in 2. https://www.wikipedia.org. 3. http://ebooks.lpude.in.statistics.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Illustrate and describe sample spaces and events for random experiments. calculate probabilities of event in discrete sample spaces and conditional probabilities of events using Baye's theorem.
CO2	Calculate the expected value of a probability distribution, obtain moments and its generating function and also obtain probability generating function
CO3	Apply the concepts of characteristic function and Chebychev's Inequality and demonstrate the theorems related to convergence in probability
CO4	Study the relationship between two or more variables
CO5	Illustrate the concept of a probability distribution and sketch the same to real world problems involving various distributions like Binomial, Poisson and Normal distribution, Uniform distributions Geometric, Exponential, Gamma, Beta distributions and identify the Inter relationship between distributions.

Mapping of Course Outcomes to Program Outcome & Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	2	2	3	3	2
CO2	3	2	2	1	2	2	2	2	2	3
CO3	3	3	2	1	1	1	2	3	2	2
CO4	3	2	1	2	2	2	2	2	2	2
CO5	3	2	1	1	2	2	2	2	3	3

1 Low 2 – Medium 3 – High

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NUMERICAL METHODS - I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Allied</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• To Solve Transcendental and Algebraic Equations
• To understand the difference operators and their relations.
• To interpolate the given data using different methods.
• To use difference formula to compute derivatives and integrals.</td></tr>
<tr><td colspan="2" rowspan="5">`Course Outline
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➢</td><td colspan="6">UNIT-I: The Solutions of Numerical Algebraic and Transcendental Equations: Introduction – Bisection method – Iteration method – Regula Falsi method – Newton – Raphson method – Horner’s Method
Chapter III: Sections – 1 to 5, 8</td></tr>
<tr><td colspan="6">UNIT-II: Simultaneous Linear Algebraic equations: Introduction – Gauss Elimination method – Computation of the inverse of a matrix using Gauss Elimination method – Method of Triangularisation – Iterative methods
Chapter IV: Sections – 1 to 4, 6</td></tr>
<tr><td colspan="6">UNIT-III: Finite Differences: Backward differences – central difference notations – Properties of the Operator △ - Difference of polynomials – Factorial polynomials – The Operator E – Relation between E and △ - Relation between D and △ – Relation between the operators - Summation of Series
Chapter V: Sections: 6, 8, 10 – 12, 14 – 16, 18, 19</td></tr>
<tr><td colspan="6">UNIT-IV: Central Difference Interpolation Formulae: Gauss forward and backward interpolation formula – Stirling’s formula – Bessel’s formula
Chapter VII: Sections: 3 – 6</td></tr>
<tr><td colspan="6">UNIT-V: Interpolation with unequal intervals; Divided differences - properties of divided differences – Newton’s interpolation formula for unequal intervals - Lagrange’s formula for interpolation
Chapter 8: Sections: 1 – 4</td></tr>
</table>

Recommended Text	Numerical Methods in Science and Engineering,Dr. M. K. Venkatraman, The National Publishing Company, Madras – 600 001. (Third Edition)
Reference Books	1. Numerical Method, P.Kandasamy, K.Thilagavathy, K.Gunavathy, S.Chand and company Ltd., New Delhi (Reprint 2002) 2. Numerical Methods for Scientific and Engineering Computations, M.K.Jain, S.R.K.Iyankar, R.K.Jain, (Sixth Edition), New Age International (P) Ltd. Publishers, New Delhi. 3. Numerical Methods, A.Singaravelu, Meenakshi Agencies, Chennai – 601302.
Website and e-Learning Source	https://ocw.mit.edu/courses/mathematics/18-336-numerical-methods-for-partial-differential-equations-spring-2009/ https://www.mathworks.com

Course Outcomes: At the end of the course, students will be able to

CO1	Solve algebraic and transcendental equations using bisection method, iteration method, regula falsi method, and Newton Raphson method.
CO2	Solve simultaneous linear equations using Gauss elimination method, Gauss Jordon method, and Gauss Seidel method.
CO3	Use finite differences to calculate differences of a polynomial, factorial polynomials, differences of zero, and summation series.
CO4	Perform interpolation using central differences formulae, and Gauss forward and backward formulae.
CO5	Perform Numerical differentiation and integeration.

Mapping of Course Outcomes to Program Outcome & Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	2	2	2
CO2	2	3	2	2	3	1	2	2	2	2
CO3	2	2	2	2	2	2	2	2	3	2
CO4	2	3	2	2	2	2	3	2	2	2
CO5	3	2	2	2	2	2	2	2	2	3

1 Low 2 – Medium 3 – High

Title of the Course		INTEGRAL TRANSFORMS					
Paper Number		VII					
Category	Core	Year / Semester	II / IV	Credits	4	Course Code	

Course Objectives:

- To understand Laplace Transform
- To apply Laplace transform to solve differential equations
- To analyse Fourier series and its applicability
- To compute Fourier Transform

Course Outline	**Unit I:** The Laplace Transforms-Definitions-Sufficient conditions for the existence of the Laplace transform(without proof)-Laplace transform of periodic functions-some general theorems-evaluation of integrals using Laplace transform-Problems. Chapter 5: Section-1 to 5.
	Unit II: The inverse Laplace Transforms- Applications of Laplace Transforms to ordinary differential equations with constant co-efficients and variable co-efficients, simultaneous equations and equations involving integrals-Problems. Chapter 5: Section-6 to 12.
	Unit III: Fourier series- Expansion of periodic functions of period 2π-Expansion of even and odd functions, Half range Fourier series-Change of intervals –Problems. Chapter 6: Section-1 to 6
	Unit IV: Fourier Transform- Infinite Fourier Transform(Complex form) – Properties of Fourier Transform . Chapter 6: Section-8 to 10.
	Unit V: Fourier cosine and Fourier sine Transform – Properties – Parseval's identity – Convolution theorem - Problems. Chapter 6: Section-11 to 15.

Recommended Text Book:

1. "Calculus-Volume III" – S.Narayanan and T.K.ManicavachagamPillai.
S. Viswanathan Publishers Pvt. Ltd. 2006

Reference Books

1. Engineering Mathematics Volume III, P. Kandasamy and Others,
(S. Chand and Co)
2. Advanced Engineering Mathematics – Stanley Grossman and William R. Devit
3. Engineering Mathematics III, A. Singaravelu, Meenakshi Agency, Chennai 2008.
4.Engineering Mathematics for Semester III- Third Edition – T.Veerarajan ,Tata McGraw-Hill Publishing Company Ltd, New Delhi

Website and e-Learning source
https://nptel.ac.in https:www.mathhelp.com/

Course Outcomes: At the end of the course, students will be able to

CO1	Analyse Laplace transform and the conditions of existence of Laplace transform
CO2	Implement the Laplace transform technique to solve differential equations
CO3	Study the expansion of periodic functions using Fourier Series
CO4	Demonstrate the Fourier transform and its properties
CO5	Illuminate problems using Fourier cosine and Fourier sine Transform .

Mapping of Course Outcomes to Program Outcome & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	2	2	2	2	2
CO2	2	3	1	1	1	1	2	1	2	2
CO3	2	2	2	2	2	2	2	2	3	2
CO4	2	3	2	2	2	2	3	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2

1 Low 2 – Medium 3 – High

Title of the Course		DISCRETE MATHEMATICS					
Paper Number		VIII					
Category	Core	Year / Semester	II / IV	Credits	4	Course Code	

Course Objectives: Students will acquire knowledge

- To apply tools and ideas in Mathematics for solving Applied Problems.
- To Evaluate Boolean functions and to express a logic sentence in terms of predicates, quantifiers, and logical connectives.

COs	CONTENTS OF MODULE
CO1	**UNIT-I:** Integers: Set, some basic properties of integers, Mathematical induction, divisibility of integers, representation of positive integers **Chapter 1 - Sections 1.1 to 1.5**
CO2	**UNIT- II:** Boolean algebra &Applications: Boolean algebra, two element Boolean algebra, Disjunctive normal form, Conjunctive normal form **Chapter 5 - Sections 5.1 to 5.4**
CO3	**UNIT–III:** Application, Simplification of circuits, Designing of switching circuits, Logical Gates and Combinatorial circuits. **Chapter 5 - Section 5.5, 5.6**
CO4	**UNIT-IV:** Recurrence relations and Generating functions: Sequence and recurrence relation, Solving recurrence relations by iteration method, Modeling of counting problems by recurrence relations, Linear (difference equations) recurrence relations with constant coefficients, Generating functions, Sum and product of two generating functions, Useful generating functions, Combinatorial problems. **Chapter 6 - Section 6.1 to 6.6**
CO5	**UNIT-V:** Proportional logic and Predicate logic: Proportional logic, Adequate system of connectivies, Translation of sentences in a Natural Language into Statement Formula, Logical validity of arguments, Predicate Logic, Negation of a statement obtained by qualification of a predicate, Logical operations on predicates or quantified predicates, Symbolization of sentences by using predicates, Quantifiers and connectives, Logical validity of arguments. **Chapter 8 - Sections 8.1, 8.5 to 8.8 (Omit Section 8.2 to 8.4)**

Contents and treatment as in	"Introduction to Discrete Mathematics", 2nd edition, 2002 by M. K. Sen and B. C.Chakraborty, Books and Allied Private Ltd., Kolkata.
Reference Books	1. Discrete mathematics for computer scientists and mathematicians by J. L.Mertt,AbrahamKendel and T. P. Baker prentice-hall, India. 2. Discrete mathematics for computer scientists by John Truss-Addison Wesley. 3. Elements of Discrete Mathematics, C. L. Liu, New York Mcgraw-Hill, 1977.
e-Resources:	1. https://brilliant.org/wiki/discrete-mathematics/. 2. https://www.tutorialspoint.com/discrete_mathematics/.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Analyse the divisibility of integer and also representation of
CO2	Apply Boolean algebra concepts in disjunctive and conjunctive normal form
CO3	Identifying, designing and analyzing circuits, logical gates and combinatorial circuits
CO4	Demonstrate recursive function and classify homogeneous and non- homogeneous linear recurrence relations
CO5	Demonstrate Proportional logic and Predicate logic

Mapping of Course Outcomes to Program Outcome & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1	1	1	1	1	2	2
CO2	3	2	1	1	1	2	1	2	2	2
CO3	2	3	2	1	1	1	1	1	2	2
CO4	2	2	1	1	1	2	1	1	2	2
CO5	2	3	2	1	1	1	1	1	3	3

1 Low 2 – Medium 3 – High

Title of the Course		PROBABILITY AND STATISTICS – II					
Paper Number		IV					
Category	Allied	Year	II	Credits	5	Course Code	
		Semester	IV				

Learning outcomes: Students will acquire knowledge

- To provide the foundation of statistical analysis used in varied application
- Of Sampling methods, Tests of significance and testing of hypothesis.

COs	CONTENTS OF MODULE
CO1	**UNIT-I:** Sampling Distributions – Concept of Standard error – Sampling distribution based on normal distribution- t, z, Chi Square and F distributions. Chapter - 12: Sections -12.1 - 12.3.1. Chapter - 13: Sections - 13.1 - 13.3.3. Chapter - 14: Sections - 14.1 - 14.5.2.
CO2	**UNIT- II** Point estimation – Concepts of unbiasedness – consistency – efficiency and sufficiency- Cramer Rao inequality – Methods of estimation- Maximum likelihood- moments - minimum square and their properties (Statement only). Chapter - 15: Sections - 15.1 - 15.4
CO3	**UNIT–III:** Test of significance – Standard error- Large sample test, Exact test based on normal, t, chi-square and F distribution with respect to population mean/means, proportion/proportions, variance and correlation coefficient. Test of independence of attributes based on contingency tables- Goodness of fit based on chi-square. Chapter - 12: Sections - 12.3.2.- 12.9 Chapter - 13: Sections - 13.5.2,13.5.3
CO4	**UNIT-IV:** Analysis of Variance: One way, two way classification concepts &Problems. Interval estimation – Confidence intervals for population mean/means- Proportion/proportions and variances based on t, Chi-Square and F. Chapter - 17: Sections - 17.1 - 17.3
CO5	**UNIT-V:** Test of hypothesis- Type I and II errors- Power of test – Neymann Pearson lemma- Likelihood ratio test-concepts of most powerful test- statements and results only-simple problems. Chapter - 16: Sections - 16.1 - 16.5

Recommended Text:

Elements of Mathematical Statistics, by S.C.Gupta &V.K.Kapoor, Sultan Chand & Sons,New Delhi.

Reference Books	
	1. Hogg R.V. & Craig A.T. (1988): Introduction to Mathematical Statistics, McMillan. 2. Mood A.M. &Graybill F.A. &Boes D.G. (1974): Introduction to theory of Statistics,McGraw Hill. 3. Snedecor G.W. & Cochran W.G(1967) : Statistical Methods, Oxford and IBH. 4. Hoel P.G. (1971) : Introduction to Mathematical Statistics, Wiley. 5. Wilks S.S. Elementary Statistical Analysis, Oxford and IBH.

e-Resources:	1. https://nptel.ac.in 2. https://www.wikipedia.org. 3. http://ebooks.lpude.in.statistics.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Identify a statistic and point out its importance in application and summarize the theoretical aspect of normal and non-normal populations.
CO2	Explain the bound for defining most efficient estimates derived from Rao Cramer inequality and compare the process of finding interval estimation with the process of finding point estimation.
CO3	Fit best approximation for a given set of data and also compare and analyze whether two sets of data are coming from same population or different population
CO4	Analyze the variability of samples under the given distributions and also obtain its confidence intervals
CO5	Point out the existence of most powerful test by summarizing the theoretical aspects of Neymann Pearson result.

Mapping of Course Outcomes to Program Outcome & Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**1**	**1**	**1**	**3**	**3**	**2**	**2**
CO3	**2**	**3**	**3**	1	1	2	**1**	**2**	**2**	**2**
CO4	**3**	**3**	**2**	1	1	2	**2**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	1	1	2	**1**	**2**	**2**	**2**

1 Low 2 – Medium 3 – High

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Numerical Methods- II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">Allied Paper</td></tr>
<tr><td>Category</td><td>Allied</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td></td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>IV</td><td colspan="4"></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• To introduce students to numerical differentiation and integration.
• To teach students how to solve difference equations.
• To familiarize students with the concept of Numerical solution of ordinary differential equations.</td></tr>
<tr><td colspan="2">Course Outline</td><td colspan="6">UNIT-I: Numerical differentiation; Derivatives using Newton’s forward and backward difference formulae – derivatives using Sterling’s formula – derivatives using divided difference formula – Simple Problems.
Chapter: 7 Sections: 7.1 – 7.4 [Omit 7.5 and 7.6]</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-II: Numerical Integration; General quadrature formula – Trapezoidal rule - Simpson’s one third rule – Simpson’s three- eight rule – Weddle’s rule – Simple Problems.
Chapter: Section 7.7 – 7.11, 7.13 – 7.15 [Omit 7.12]</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-III: Difference equation: Definition – order and degree of a difference equation - Linear difference equation – Complementary function and particular integral of f(E) $y_x = \phi(x)$.
Chapter: 8 Sections: 8.1 – 8.6</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-IV: Numerical solution of ordinary differential equations(I order only) Taylor’s series method – Picard’s method – Eulers’ method – Simple Problems
Chapter: 9: Sections : 9.5 – 9.7</td></tr>
<tr><td colspan="2"></td><td colspan="6">UNIT-V: Numerical solution of ordinary differential equations (I order only) Modified Euler’s method – Runge – kutta method forth order only - Simple Problems
Chapter 9: Sections: 9.9 – 9.11</td></tr>
</table>

Recommended Text	Calculus of finite differences and Numerical Analysis, by P.Kandasamy & K.Thilagavathy - S.Chand & Co Pvt Ltd.
Reference Books	1. Calculus of finite differences and Numerical analysis by Gupta-Malik, Krishna Prakastan, Mandir, Meerut. 2. Numerical Methods in Science and Engineering by M.K.Venkataraman, National Publishing house, Chennai. 3. Numerical Analysis by B.D.Gupta, Konark Publishing 4. Calculus of finite differences and Numerical Analysis by Saxena, S.Chand & Co
Website and e-Learning Source	https://ocw.mit.edu/courses/mathematics/18-336-numerical-methods-for-partial-differential-equations-spring-2009/ https://www.mathworks.com

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Find numerical differentiation using types of interpolation formulae
CO2	Find numerical integration using Trapezoidal rule - Simpson's 1/3 rule – Simpson's 3/8 rule – Weddle's rule
CO3	Solve linear homogeneous & non-homogeneous difference equation with constant coefficients and calculate particular integrals
CO4	Find numerical solution to ODE using Taylor's series, Picard's & Eulers' Method
CO5	Find numerical solution to ODE using Modified Euler's method & 4th order RK method.

Mapping of Course Outcomes to Program Outcomes & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PS02**	**PS03**
CO1	2	2	2	2	2	2	2	3	3	2
CO2	3	2	2	2	2	3	2	3	2	3
CO3	3	3	1	1	1	2	2	3	1	2
CO4	2	3	1	1	1	2	1	2	2	2
CO5	3	2	1	2	2	2	2	3	2	2

1 Low 2 – Medium 3 – High

Title of the Course		ALGEBRAIC STRUCTURES					
Paper Number		IX					
Category	Core	Year / Semester	III / V	Credits	4	Course Code	

Course Objectives:

Students will acquire knowledge about the concepts of Sets, Groups and Rings.

COs	CONTENTS OF MODULE
CO1	**Unit I:** Introduction to groups- Subgroups- cyclic groups - Lagrange'sTheorem- A counting principle-Examples **Chapter 2: Section 2.4 and 2.5.**
CO2	**Unit II:** Normal subgroups and Quotient group- Homomorphism- Automorphism- Examples. **Chapter 2: Section 2.6 to 2.8**.
CO3	**Unit III:** Cayley's Theorem- Permutation groups-Examples. **Chapter 2: Section 2.9 and 2.10.**
CO4	**Unit IV:** Definition and examples of ring- Some special classes of rings- homomorphism of rings- Ideals and quotient rings- More ideals and quotient rings. **Chapter 3: Section 3.1 to 3.5.**
CO5	**Unit V:**The field of quotients of an integral domain- Euclidean Rings- The particular Euclidean ring-Examples. **Chapter 3:Section 3.6to 3.8.**

Contents and treatment as in

Topics in Algebra – I. N. Herstein, Wiley Eastern Ltd Second Edition (1st January 2006)

Reference Books

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1. A First Course in Abstract Algebra, John B. Fraleigh, 7th Ed., Pearson, 2002.
2. Abstract Algebra, M. Artin, 2nd Ed., Pearson, 2011.
3. Contemporary Abstract Algebra, Joseph A Gallian, 4th Ed., Narosa, 1999
4. Modern Algebra by M.L.Santiago, McGraw Hill Education India pvt Ltd
5. Modern Algebra by S. Arumugam and others, New Gamma publishing House, Palayamkottai.
6. Modern Algebra by Visvanathan Nayak, Emerald Publishers, Reprint 1992

Website and e-Learning Source

1. https://nptel.ac.in
2. http://garsia.math.yorku.ca/~sdenton/algstruct.
3. https://nptel.ac.in https://www.mathhelp.com/

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Summarize the structure of Group, Subgroups and Demonstrate operations satisfying various properties in group structure.
CO2	Explain normal subgroups, quotient groups, homomorphism, automorphism and demonstrate with an example.
CO3	Explain Cayley's theorem, the permutations groups with an example.
CO4	Define Rings, some special classes of rings with an example and Explain ideals and quotient Rings
CO5	Illustrate Imbedding of Integral domain over Field and demonstrate the Euclidean Rings.

Mapping of Course Outcomes to Program Outcomes & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PS02**	**PS03**
CO1	3	3	2	2	1	2	2	3	3	2
CO2	3	3	2	2	1	2	2	3	2	3
CO3	3	3	1	1	1	2	1	3	1	2
CO4	3	3	1	1	1	2	1	2	2	2
CO5	3	2	1	2	1	2	2	3	2	2

1 Low 2 – Medium 3 – High

Title of the Course		REAL ANALYSIS-I					
Paper Number		X					
Category	Core	Year / Semester	III / V	Credits	4	Course Code	

Course objectives

- To make the students capable of analysing any given sequence and series
- To calculate limit superior, limit inferior and the limit of a sequence
- To learn certain proof techniques and write precise proof of theorems
- To recognize alternating, conditionally convergent and absolutely convergent series

CONTENTS OF MODULE
Unit I: Sets and Functions: Sets and elements- Operations on sets- functions- real valued functions- equivalence- countability - real numbers- least upper bounds. **Chapter 1 Section 1.1 to 1.7**
Unit II: Sequences of Real Numbers: Definition of a sequence and subsequence- limit of a sequence- convergent sequences- divergent sequences- bounded sequences- monotone sequences **Chapter 2 Section 2.1 to 2.6**
Unit III: Operations on convergent sequences- operations on divergent sequences- limit superior and limit inferior- Cauchy sequences. **Chapter 2 Section 2.7 to 2.10**
Unit IV: Series of Real Numbers: Convergence and divergence- series with non-negative terms- alternating series- conditional convergence and absolute convergence- tests for absolute convergence- series whose terms form a non-increasing sequence- the class l^2 . **Chapter 3 Section 3.1 to 3.4,3.6,3.7 and 3.10**
Unit V: Limits and Metric Spaces: Limit of a function on a real line-. Metric spaces - Limits in metric spaces. Continuous Functions on Metric Spaces: Function continuous at a point on the real line- Reformulation- Function continuous on a metric space. **Chapter 4 Section 4.1 to 4.3 Chapter 5 Section 5.1 to 5.3**

Recommended Text: Contents and treatment as in

Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co.

Reference Books:

1. Principles of Mathematical Analysis by Walter Rudin,TataMcGrawHill.
2. Mathematical Analysis Tom M Apostol, Narosa Publishing House

Website and e-Learning Source

https://nptel.ac.in https:www.mathhelp.com/

Course outcomes: At the end of the course, students will be able to

CO1	Describe the fundamental properties of the real numbers that lead to the formal development of real analysis and recognize the basic properties of the field of real numbers, cardinality of a sets.
CO2	Demonstrate the concepts of limits in sequences and examine the basic principles of convergence and conditions of the convergent, divergent of a sequence.
CO3	Estimate the limit superior, limit inferior, limit of a sequence and explain Cauchy sequence.
CO4	Construct mathematical proofs of convergence test of a sequence and distinguish between conditional convergence and absolute convergence. Explain and demonstrate the basic concepts of absolute convergence of a sequence and derive the 'test for convergence' using summation by parts.
CO5	Explain the Euclidian distance function and the geometric meaning of each of the metric space properties and point out whether a given distance function is a metric.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**
CO2	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**2**	**2**
CO3	**2**	**2**	**2**	**1**	**1**	**3**	**2**	**2**	**2**	**2**
CO4	**3**	**2**	**1**	**1**	**1**	**3**	**1**	**3**	**2**	**3**
CO5	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**2**	**3**

1 Low 2 – Medium 3 – High

Title of the Course		MECHANICS					
Paper Number		XI					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				

Course objectives

- Students will acquire knowledge about
- Particles or body in rest under the given forces. Forces, equilibrium of a particle and centre of mass of various bodies.
- The motion of bodies under the influence of forces. Rectilinear motion of particles, Projectiles and Moment of Inertia of Particles.

COs	CONTENTS OF MODULE
CO1	**Unit 1** Force- Newtons laws of motion - resultant of two forces on a particle- Equilibrium of a particle, Limiting equilibrium of a particle on an inclined plane. Chapter 2 - Section 2 .1 , 2.2 , Chapter 3 - Section 3.1 -3.2
CO2	**Unit 2** Forces on a Rigid Body: Moment of a Force – General motion of a body – Equivalent systems of forces- Parallel Forces, Forces along the sides of a triangle – Couples. A hanging body in equilibrium, Hanging strings- equilibrium of a uniform homogeneous string – suspension bridge. Chapter 4 : Sections 4.1 to 4.6 Chapter 9 - Section 9.1, 9.2.
CO3	**Unit 3** Kinematics -Basic units – velocity – acceleration- coplanar motion . Rectilinear motion under varying Force: Simple harmonic motion (S.H.M.) – S.H.M. along a horizontal line- S.H.M. along a vertical line Chapter 1 - Section 1.1 to 1.4 Chapter 12 - Section 12.1 to 12.3
CO4	**Unit 4** Projectiles -Forces on a projectile- projectile projected on an inclined plane. Moment of inertia, Perpendicular and parallel axes theorem Chapter 13 - Section 13.1, 13.2 Chapter 17 - Section 17.1, 17.1.1
CO5	**Unit 5** UNIT-V: Central Orbits: General orbits – Central orbit – Conic as a centered orbit Chapter 16 - Section 16.1 to 16.3

Contents and treatment as in

Mechanics, by P.Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam, S.Chand and company private limited Reprint 2016.

Reference Books

1. Engineering Mechanics: Statics, J.L. Meriam and L. G. Kraige, Seventh Edition,Wiley and sons Pvt ltd., New York, 2012.
2. Engineering Mechanics: Dynamics, J.L. Meriam, L. G. Kraige, and J.N. Bolton, 8th edition Wiley and sons Pvt ltd., New York, 2015.
3. Engineering Mechanics (Statics and Dynamics)A. K. Dhiman, P.Dhinam and D. Kulshreshtha, McGraw Hill Education(India) Private Limited, New Delhi, 2015.
4. Introduction to Statics and Dynamics , A. Ruina and R. Pratap, Oxford University Press, 2014.
5. The Elements of Statics and Dynamics, S.L. Loney, Cambridge University Press, 1904.
6. Dynamics – K. ViswanathaNaik and M. S. Kasi, Emerald Publishers.
7. Dynamics – A. V. Dharmapadam, S. Viswanathan Publishers.

e-Resources:

1. https://www.wikipedia.org/
2. https://physics.info

Course outcomes: At the end of the course, the student will be able to

CO1	Recall the basic definitions of forces, Newtons laws of motion, Equilibrium of a particle.
CO2	Distinguish problems under moments, parallel forces and couples. Explain hanging body in equilibrium and demonstrate problems under hanging strings.
CO3	Recall the basic definitions of velocity, acceleration, coplanar motion simple harmonic motion and demonstrate problems under Simple harmonic motion.
CO4	Recall concepts of projectiles, differentiate time of flight, horizontal range. Explain moment of Inertia of simple bodies and theorems of parallel and perpendicular axes
CO5	Define circular motion, central orbits, and evaluate various problems centered orbit .

Mapping of Course Outcomes to Program Outcomes & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PS02**	**PS03**
CO1	3	3	2	1	1	2	2	3	3	2
CO2	3	3	2	1	1	2	2	3	2	3
CO3	3	3	1	1	1	2	1	3	1	2
CO4	3	3	1	1	1	2	1	2	2	2
CO5	3	2	1	2	1	2	2	3	2	2

1 Low 2 – Medium 3 – High

Title of the Course		OPERATIONS RESEARCH					
Paper Number		XII					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	V				

Course objectives

- To formulate and solve the Linear Programming Problem from the real-world problems in business and industry.
- Develop mathematical skills to analyze and solve network models arising from a wide range of applications.

CONTENTS OF MODULE
Unit -1: Linear programming – Formulation – Graphical solution – Simplex method – Simple applications. Big-M method. **Chapter - 2,3,4**
Unit -2: Linear programming - Principle of Duality – Primal – Dual relation -Dual simplex method – Simple applications. **Transportation Problem**: Finding initial solution by North West Corner Rule – Vogel's Approximation method and Matrix minimum method – Procedure for finding optimal solution –MODI method – Both minimisation and maximisation cases – Unbalanced and degenerate transportation problems. **Chapter 5 : 5.1 – 5.4, 5.7** **Chapter 10: 10.1-10.13**
Unit -3: Assignment Problem: Formulation – Minimisation cases – procedure for getting optimum solution – Unbalanced problem – Maximisation problem – Problems with restrictions. **Game Theory**: Two Person Zero-Sum game with saddle point – without saddle point – dominance rule – Solving 2 x n or m x 2 game by graphical method. **Chapter 11: 11.1 – 11.4** **Chapter 17: 17.1 -17.7**
Unit -4: Networks: Rules for network construction – Critical Path Method - Time calculation sin PERT – PERT algorithm (Crashing excluded) – Related problems. **Chapter 25**
Unit -5: Sequencing Problem – n jobs through 2 machines – n jobs through 3 machines – n jobs through m machines. Graphical method. **Chapter 12: 12.1 – 12.6**

Recommended Text :

*KanthiSwaroop, P.K. Gupta,Manmohan,*Operations Research –Sultan Chand & sons (2021) reprint.

Reference Books:

1.P.K. Gupta and D. S. Hira, Operations Research, S. Chand & Co.

1. *H.A. Taha*, Operations Research Prentice Hall of India, New Delhi
2. *Sundaresan, Ganapathy Subramanian, Ganesan.,*Resource Management Technique – Meenakshi Agency.

Website and e-Learning Source https://nptel.ac.in https://www.mathhelp.com/

Course outcomes: At the end of the course, students will be able to

CO1	Able to formulate linear programming problems and solve using Graphical, Simplex method.
CO2	Able to analyze and solve Transportation using appropriate method.
CO3	Able to analyze and solve Assignment problems and Game theory.
CO4	Able to design and solve Networks Models using CPM, PERT.
CO5	Estimate optimum solution for sequencing problems.

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**3**
CO2	**2**	**3**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**1**	**2**	**1**	**3**	**2**	**3**	**2**	**3**
CO4	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**2**

1 Low 2 – Medium 3 – High

Title of the Course		PROGRAMMING IN PYTHON WITH PRACTICALS - I					
Paper Number		ELECTIVE - I					
Category	ELECTIVE	Year / Semester	III / V	Credits	4	Course Code	

Course objectives

- To learn and understand Python programming basics and paradigm.
- To learn and understand data types, operators, control statements, and looping.
- To learn and know the concepts of functions.

CONTENTS OF MODULE
UNIT-I : Basics of Python Programming: Features – History – Future – Python Interpreter and Interactive Mode – Writing and Executing First Python Programme – Values and Types – Numbers – Boolean – Lists – Strings – Variables and Identifiers – Data Types – Statements – Reserved Words – Tuple Statement – Dictionary. **Chapter 2: Section 2.1 – 2.16.**
UNIT-II: Operators and Expressions – Expressions in Python – Operations on Strings – Type Conversion – Comments – Functions and Modules. **Chapter 2: Section 2.17 – 2.22.**
UNIT-III: Control Flow Statements: Introduction to Decision Control Statements – Selection / Conditional Branching Statements – Basic Loops Structures – Nested Loops. **Chapter 3: Section 3.1 – 3.4.**
UNIT-IV: Break Statement – Continue Statement – Pass Statement – Else Statement Used with Loops. Functions: Introduction – Defining a function– Function Call – Variable Scope and Lifetime. **Chapter 3: Section 3.5 – 3.8.** **Chapter 4: Section 4.1 – 4.4.**
UNIT-V: Fruitful Function –Lambda – Function Composition – Documentation Strings –Recursive Functions. Chapter 4: Section 4.5 – 4.10 (Omit 4.9)

Recommended Text:

"Problem Solving and Programming with Python", by ReemaThareja (Second Edition, 2019, OXFORD University Press)

Reference Books:

1. "Problem Solving and Python Programming" by Mr. Ashok NamdevKamthane and Mr.Amit Ashok Kamthane (McGraw Hill Education (India) Private Limited).
2. "Python Programming" by Ch.Sathyanarayana, M.Radhika

e-Resources:

https://www.pythonforbeginners.com/
https://www.w3schools.com/

Course outcomes: At the end of the course, students will be able to

CO1	Understand the concept of variables, data types in python programming.
CO2	Understand the concept of Operators and Expressions
CO3	Understand Control Statements and Looping
CO4	Understand Statements and Function concepts.
CO5	Apply the concept of functions in python programming.

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**2**	**2**	**3**	**2**	**3**	**1**	**2**
CO2	**1**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**3**	**3**
CO3	**3**	**1**	**2**	**2**	**2**	**1**	**2**	**3**	**2**	**2**
CO4	**2**	**3**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**1**
CO5	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**1**	**3**

1 Low 2 – Medium 3 – High

Practical Paper I: PROGRAMMING IN PYTHON LAB –I Credits: 2

1. (a) Write a program to perform addition, multiplication, division, integer division, and modulo division on two integer numbers.
   (b) Write a program to perform addition, subtraction, multiplication, and division ontwo floating point numbers.
2. (a) Write a program to calculate area and perimeter of circle.
   (b) Write a program to calculate the distance between two points.
   (c) Write a program to calculate area of triangle using Heron's formula.
3. (a) Write a program to find larger of two numbers.
   (b) Write a program to find larger of n numbers.
4. (a) Write a program to find whether the given number is odd or even.
   (b) Write a program to find whether the given number is prime or composite.
5. (a) Write a program to calculate factorial of a number.
   (b) Write a program to find square root of a given number.
6. Write a program to print the calendar of any given year.
7. Write a program that compute P(n, r) and C(n, r).
8. Write a program to calculate LCM and GCD.
9. Write a program to print the Fibonacci Series.
10. Write a program to implement Tower of Hanoi.
11. Write a program to swap two numbers.
12. Write a program to make a simple calculator.
13. Write a program to find average of given n numbers.
14. Write a program to find whether the given number is an Amstrong number or not.
15. Write a program to calculate roots of a quadratic equation.

Title of the Course		LINEAR ALGEBRA					
Paper Number		XIII					
Category	Core	Year / Semester	III / VI	Credits	4	Course Code	

Course Objectives

Students will acquire knowledge about the Vector Spaces, Dual spaces, Inner product spaces and linear transformations**.**

COs	CONTENTS OF MODULE
CO1	**UNIT-I:** Vector spaces – Subspaces – Linear Combinations and Linear span – System of linear equations – Elementary Matrices Chapter: 1 Sections:1.1–1.4..
CO2	**UNIT-II:** Linear Dependence and Linear independence – Bases - Dimensions – Homogenous Equations – Non-homogenous equations Row reduced – Echelon form. Chapter 1: Sections:1.5,1.6., Chapter 2: Section: 2.7 Chapter 3: Section 3.4
CO3	**UNIT-III:** Linear transforms, null spaces and ranges – Matrix representation of a linear transformation – Invertibility and isomorphisms – Dual spaces. Chapter 2: Sections:2.1 –2.4 and 2.6.
CO4	**UNIT – IV:** Eigen values, Eigen vectors, Diagonalizability – Invariant subspaces – Cayley – Hamilton theorem. Chapter 5: Sections:5.1,5.2 and 5.4.
CO5	**UNIT-V**: Inner Products Space:Inner Products and norms Gram-Schmidt Orthogonalization Process – Orthogonal complements. Chapter 6: Sections:6.1,6.2.

Recommended Text:

Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5 th edition (2018) Pearson

Reference Books:

1. Topics in Algebra,I.N.Herstein, Wiley EasternLtd. Second Edition, 2006.
2. University Algebra, N.S.Gopalakrishnan, New Age International Publications, Wiley Eastern Ltd.
3. First course in Algebra, John B.Fraleigh, Addison Wesley.
4. Linear Algebra and its Applications, David C. Lay, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007.
5. Introduction to Linear Algebra, S. Lang, 2nd Ed., Springer, 2005.
6. Linear Algebra and its Applications, Gilbert Strang, Thomson, 2007.

Website and e-Learning Source

https://nptel.ac.in
https://www.mathhelp.com/

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Acquire a detailed knowledge about vector spaces and subspaces
CO2	Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis.
CO3	Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces with an illustration.
CO4	Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation.
CO5	Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces.

Mapping of Course Outcomes to Program Outcomes & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PS02**	**PS03**
CO1	3	3	2	1	1	2	2	3	3	2
CO2	3	3	2	1	1	2	2	3	2	3
CO3	3	3	1	1	1	2	1	3	1	2
CO4	3	3	1	1	1	2	1	2	2	2
CO5	3	2	1	2	1	2	2	3	2	2

1 Low 2 – Medium 3 – High

Title of the Course		REAL ANALYSIS II					
Paper Number		XIV					
Category	Core	Year	III	Credits	4	Course Code	
		Semester	VI				

Course objectives

- To write clear and precise proof of theorems.
- Introduce the concepts of Riemann integrable and properties of Riemann integrable.
- To identify the correct theorems to deal with unknown problems.

CONTENTS OF MODULE
Unit I: Continuous Functions on Metric Spaces: Open sets- closed sets- Discontinuous function on R^1. Connectedness, Completeness and Compactness: More about open sets- Connected sets. **Chapter 5 Section 5.4 to 5.6** **Chapter 6 Section 6.1 to 6.2**
Unit II: Bounded sets and totally bounded sets -Complete metric spaces- compact metric spaces, continuous functions on a compact metric space, continuity of inverse functions, uniform continuity. **Chapter 6 Section 6.3 to 6.8**
Unit III: Calculus: Sets of measure zero, definition of the Riemann integral, -properties of Riemann integral. **Chapter 7 Section 7.1 to 7.4(omit 7.3)**
Unit IV: Derivatives- Rolle's theorem, Law of mean, Fundamental theorems of calculus. **Chapter 7 Section 7.5 to 7.8**
Unit V: Taylor's theorem- Pointwise convergence of sequences of functions, uniform convergence of sequences of functions. **Chapter 8 Section 8.5** **Chapter 9 Section 9.1 and 9.2**

Recommended Text Book:

Richard R. Goldberg. Methods of Real Analysis. Oxford and IBH Publishing Co)

Reference Books:

1. Principles of Mathematical Analysis by Walter Rudin,TataMcGrawHill.
2. Mathematical Analysis Tom M Apostal,Narosa Publishing House.

Course outcomes: At the end of the course, students will be able to

CO1	Examine the continuity of a functions via open and closed sets and give the definition of concepts related to metric spaces, such as continuity, compactness, completeness and connectedness
CO2	Describe about bounded, unbounded sets and distinguish between compact and complete metric spaces.
CO3	Determine the Riemann integrability of a bounded function, identify the size of a sets by outer measure and choose the Riemann integral properties to find the value of the integrals.
CO4	Demonstrate the usage of the Mean Value Theorem, Fundamental theorem of Calculus to problems in the context of real analysis and Roll's theorem, Mean value theorem for differentiable functions.
CO5	Distinguish between point wise and uniform convergence of a sequence of functions and illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**2**	**1**	**2**	**3**	**1**	**3**	**2**	**2**
CO2	**3**	**2**	**2**	**1**	**1**	**2**	**1**	**3**	**2**	**3**
CO3	**2**	**3**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**2**
CO4	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**3**
CO5	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**2**	**2**

1 Low 2 – Medium 3 – High

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">Complex Analysis</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">XV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">4</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="8">Course Objective:
➢ Explain the fundamental concepts of the functions of a complex variable and their role in modern mathematics and applied contexts.
➢ Demonstrate understanding of analytic functions and complex integration.
➢ Calculate series expansions for complex-valued functions, evaluate contour integrals and definite integrals.</td></tr>
<tr><td colspan="2" rowspan="4">Course Outline</td><td colspan="6">Unit I
Analytic functions: Limits –Limits involving the point at infinity–Theorem on limits –Continuity – Derivatives – Differentiation formulas – Cauchy Riemann equation – Sufficient conditions for differentiability – Polar coordinates– Analytic functions– Examples - Harmonic functions.
Chapter 2- Sections- 15- 26</td></tr>
<tr><td colspan="6">Unit II
Complex Integration: Contour integrals – Examples - Upper bounds for moduli of contour integrals – Simply and Multiply connected domains– Cauchy integral formula – An extension of the Cauchy integral formula – some consequences of the extension – Liouville’s theorem and Fundamental theorem of Algebra– Maximum modulus principle.
Chapter 4- Sections- 40-43,48-54 (omit 44-47)</td></tr>
<tr><td colspan="6">Unit III
Series: Convergence of sequences – Convergence of series– Taylor series – Examples- Laurent series– Examples- Absolute and uniform convergence of power Series.
Chapter 5- Sections: 55-63.</td></tr>
<tr><td colspan="6">Unit IV
Residues and Poles: Isolated singular point – Residues – Cauchy Residue theorem – residue at infinity –The three types of isolated singular points. Application of residues – Evaluation of Improper Integrals – Improper integrals from Fourier Analysis –Jordan’s Lemma (statement only) – Definite integrals involving Sines and cosines–Simple examples.
Chapter 6- Sections: 68-72 Chapter 7 – Section 78-81,85 (omit 82-84)</td></tr>
<tr><td colspan="6">Unit V
Mappings: Mappings – Mapping by exponential function – Mapping by elementary function - Linear transformation – The transformation w= 1/z – Mappings by 1/z – Linear fractional transformations (bilinear) - An Implicit form.
Chapter 2- Sections: 13, 14 Chapter 8- Sections: 90-94</td></tr>
</table>

Contents and treatment as in	James Ward Brown and Ruel V. Churchill, Complex variables and application, 8/e, Mc-Graw Hill Book Company. (2019)
Reference Books	1. Dennis G. Zill, Patrick D. Shanahan, Complex Analysis, 3/e Jones & Bartlett Learning. 2. Murray R. Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman ,Schaum's outlines Complex Variables 2/e. 3. S.Arumugam, A.Thangapandi Isaac, & A.Somasundaram, Complex Analysis, New Scitech Publications (India) Pvt Ltd (Latest Edition) 4. B.S. Tyagi, Functions of A Complex Variable Kedarnath & Ramnath, Meerut (Latest Edition) 5. A.R. Vasishtha,Complex Analysis Krishna Prakashan Media Pvt. Ltd (Latest Edition) 6. J.N. Sharma, Functions of a Complex variable, Krishna Prakasan Media Pvt Ltd, (Latest Edition)
e-Resources:	1. http://ebooks.lpude.in.complexanalysis. 2. https://nptel.ac.in.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Solve problems on analytic and harmonic functions.
CO2	Outline proof of the theorems on complex integration.
CO3	Express functions as Taylor's and Laurent's series.
CO4	Apply the concepts of residues to evaluate some real improper integrals.
CO5	Construct mappings of exponential function and 1/z

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	3	2	3	1	2
CO2	1	2	2	2	2	2	1	2	3	3
CO3	3	1	2	2	2	1	2	3	2	2
CO4	2	3	1	1	1	2	2	1	2	1
CO5	3	2	2	2	2	1	1	2	1	3

1 Low 2 – Medium 3 – High

Title of the Course		PROGRAMMING in PYTHON with PRACTICALS -II					
Paper Number		Elective- II					
Category	Elective	Year	III	Credits	3	Course Code	
		Semester	VI				

Course objectives

- To learn and understand Python programming basics and paradigm.
- To learn and understand control statements, Looping, functions and string manipulations.
- To learn and know the concepts of file handling and exception handling.

CONTENTS OF MODULE
UNIT-I: Strings: Concatenating, Appending, and Multiplying Strings – Strings are Immutable – Strings Formatting Operator – Built-in String Methods and Functions – Slice Operation. **Chapter 5: Section 5.1 – 5.5**
UNIT-II: Strings: Comparing Strings – Iterating String- **List,Tuple and Dictionaries:** Sequence – Lists. **Chapter 5: Section 5.8, 5.9** **Chapter 6: Section 6.1, 6.2**
UNIT-III: List,Tuple and Dictionaries: Tuples and Dictionaries **Chapter 6: Section 6.4, 6.5**
UNIT-IV: File handling: Introduction – File path – Types of files - Opening and Closing Files – Reading and Writing Files **Chapter 7: Section 7.1 to 7.5**
UNIT-V: File handling: File Position - % (string formatting Operator) – Renaming and Deleting Files – Directory Methods – **Error and Exception Handling:** Introduction to Error and Exception - Handling Exceptions. **Chapter 7: Section 7.6, 7.7, 7.9, 7.10** **Chapter 8: Section 8.1, 8.2**

Recommended Text:

"Problem Solving and Programming with Python", by ReemaThareja (Second Edition, 2019,OXFORD University Press)

Reference Books:

1. "Problem Solving and Python Programming" by Mr. Ashok NamdevKamthane and Mr.Amit Ashok Kamthane (McGraw Hill Education (India) Private Limited).
2. "Python Programming" by Ch.Sathyanarayana, M.Radhika

e-Resources:

https://www.pythonforbeginners.com/
https://www.w3schools.com/

Course outcomes: At the end of the course, students will be able to

CO1	Understand the concept of operators, data types in python programming.
CO2	Understand control statements and Looping
CO3	Apply the concept of functions in python programming.
CO4	Understand the concept of formatting operator and strings
CO5	Analyze the structures of list, tuples and maintaining dictionaries

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**1**	**1**	**3**	**2**	**3**	**1**	**2**
CO2	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**3**	**3**
CO3	**3**	**1**	**2**	**2**	**2**	**1**	**2**	**3**	**2**	**2**
CO4	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**1**
CO5	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**3**

1 Low 2 – Medium 3 – High

Practical Paper – II: PROGRAMMING in PYTHON Lab –II Credits: 2

Write a Python Program for the following

1. To demonstrate string references using the id() function.
2. To display powers of a number using formatting characters.
3. To understand how characters in a sting are accessed using negative indexes.
4. To take user's name and PAN card number as input. Validate the information using is X function and print the details.
5. Count the occurrences of a character in a string.
6. Program to reverse the string.
7. Calculate the distance between two points.
8. To add two matrices.
9. Print a histogram of frequencies of characters occurring in a message.
10. Copies one python script into another in such a way that all comment lines are skipped and not copied in the destination file.
11. Accepts filename as an input from the user. Open the file and count the number of times a character appears in the file.
12. Reads data from a file and calculate the percentage of vowels and consonants in the file
13. Counts the number of tabs, spaces and newline characters in a file.
14. Write a program for BINARY SEARCH
15. Calculate GCD of two numbers.

Title of the Course		GRAPH THEORY AND ITS APPLICATIONS					
Paper Number		Elective- III					
Category	Elective	Year	III	Credits	3	Course Code	
		Semester	VI				

Course objectives

- Understand the fundamental concepts of graph theory.
- Learn about the connectivity and separability of graphs.
- Develop an understanding of vector spaces of a graph
- Gain knowledge about matrix representation of a graph

CONTENTS OF MODULE
UNIT I Basics: Graphs – Pictorial representation – Subgroups – Isomorphism and degrees – Walks and connected graphs – Cycles in Graphs – Cut-vertices and cut-edges. Chapter 1: Sections: 1.1 – 1.7
UNIT-II Eulerian and Hamiltonian Graphs: Eulerian graphs – Fleury's algorithm – Hamiltonian graphs – weighted graphs. Chapter 2: Sections 2.1 – 2.4
UNIT-III: Bipartite Graphs and Matrices: Bipartite graphs – Marriage problem – Trees – Connector problem – Matrix representations – Vector spaces associated with graphs – Cycle space – Cut-set space. Chapter 3: Section 3.1 – 3.4 Chapter 4: Section 4.1
UNIT-IV : Planar Graphs: Planar Graphs – Euler formula – Platonic solids – Dual of a plane graph. Chapter 5: Section 5.1 – 5.4
UNIT-V: : Colourings: Vertex colouring – Edge colouring – An algorithm for vertex colouring. Chapter 6: Section 6.1 – 6.3

Recommended Text:

A First Course In Graph Theory, Choudum.S.A. –Macmillan India Limited, 1987

Reference Book:

1. Introduction to Graph Theory, Murugan.M –Muthali Publishing House, Chennai, 2005.
2. Invitation to Graph Theory, Arumugam.S and S. Ramachandran, - Scitech publications India Pvt. Limited, Chennai – [2001, Edition].
3. Introduction to Graph Theory: D.B. West (2001) Prentice Hall.

Website and e-Learning Source

https://nptel.ac.in/courses/111106050

Course outcomes: At the end of the course, students will be able to

CO1	Illustrates basic graphs and it's properties
CO2	Describe Euler and Hamiltonian graphs.
CO3	Illuminate bipartite graphs and matrices
CO4	Define Planar graphs, Euler formula and dual plane graph
CO5	Demonstrate colourings of a graph.

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1	2	2	2	1	2	2
CO2	2	2	1	2	2	1	1	1	2	2
CO3	3	2	1	1	2	1	2	2	3	2
CO4	2	2	1	1	3	2	2	2	2	3
CO5	3	2	2	1	2	2	2	2	2	2

1 Low 2 – Medium 3 – High

Title of the Course		MATHEMATICAL STATISTICS With R					
Paper Number		Elective					
Category	Elective	Year	III	Credits	3	Course Code	
		Semester	VI				

Course objectives

- Students gain knowledge about Random Variables, Generating Functions, Correlation and Regression.
- They also learn the basic concepts of Standard Distributions, estimation theory and finding the method of estimators.
- Also, they learn some concepts in testing of hypothesis.

CONTENTS OF MODULE
UNIT – I: Random variables (discrete and continuous), Distribution function - expected values and Moments – Moment generating function Characteristic function – Uniqueness Theorem (Statement Only) Chebychev's inequality – Simple problems
UNIT-II: Concepts of bivariate distributions – Correlation & Regression – Rank Correlation Coefficient – Simple Problems.
UNIT-III: Standard Distributions Normal - Uniform distributions – Sampling Theory – Sampling Distributions – Concept of Standard error – Sampling Distribution based on Normal, t, Chi-Square and F distributions.
UNIT-IV: Test of Significance – Tests of Hypothesis –Large Sample Test – Exact test based on Normal, t, Chi-Square and F distributions with respect to Population Mean and Variance
UNIT-V: Type I and Type II Errors – Test of Independence of Attributes based on contingency tables – Goodness of fit based on Chi-Square – Simple Problems.

- **Lab sessions for each unit using R software will be taken.**

Recommended Text:

Elements of Mathematical Statistics by S.C.Gupta & V.K Kapoor – S.Chand & Co

Reference Book:

1. Fundamentals of Mathematical by Statistics, S.C.Gupta & V.K Kapoor –S. Chand & Co
2. Introduction to Mathematical Statistics,Hogg, R.V Craig A.T(1988) ; McMillan
3. Introduction to theory of Statistics, Mood A.M & Graybill F.A & Boes D.G(1974) McGraw Hill.
4. Statistical Methods, Snedecor G.W & Cochran W.G(1967) ; Oxford and IBH.
5. Mathematical Statistics by P. R. Vittal, Margham Publications

Title of the Course		MATHEMATICAL MODELING					
Paper Number		Elective					
Category	Elective	Year / Semester	III / VI	Credits	3	Course Code	

Learning outcomes:

Students will acquire knowledge about

- Construction and Analysis of Mathematical models inspired by real life problems.
- The Meaning of Equations and Functional Relationships.

UNIT I

Mathematical Modeling: Simple situations requiring mathematical modeling, characteristics of mathematical model.

Chapter 1 Sections 1.1-1.5

UNIT II

Mathematical Modeling through differential equations: Linear Growth and Decay Models. Non-Linear growth and decay models, Compartment models.

Chapter 2 Sections 2.1- 2.4

UNIT III

Mathematical Modeling, through system of Ordinary differential equations of first order: Prey-predator models, Competition models, Model with removal and model with immigrations.

Epidemics: simple epidemic model, Susceptible-infected- susceptible(SIS) model, SIS model with constant number of carriers.

Medicine : Model for Diabetes Mellitus.

Chapter 3 Sections 3.11, 3.12,3.2.and 3.51

UNIT IV

Introduction to difference equations. Chapter 5

Sections 5.1 and 5.2

UNIT V

Mathematical Modeling, through difference equations:Harrod Model, cobweb model application to Actuarial Science

Sections 5.3 (5.3.3 not included)

Content and treatment as in

J N Kapur, Mathematical Modeling, New Age International publishers.(2009).

Reference:-

1. Mathematical Modeling by Bimalk . Mishra and Dipak K.Satpathi.

e- Resources:

1. https://nptel.ac.in

Title of the Course		SPECIAL FUNCTIONS					
Paper Number		Elective					
Category	Elective	Year / Semester	III / VI	Credits	3	Course Code	

Learning outcomes:

Students will acquire knowledge about

- The mathematical concepts of Special Functions.
- Developing series solution of Differential Equations.
- The concepts of Legendre polynomial, Bessel functions and Gamma functions.

UNIT I

Introduction and Review of power series – Series solution of first order differential equations Chapter 5 Sections 26 and 27

UNIT II

Second order linear differential equations-Regular, singular points.
Chapter 5 Sections 28 and 29

UNIT III

Regular singular points continued: Gauss's hyper geometric equations.
Chapter 5 Sections 30 and 31

UNIT IV

Legendre polynomials-Properties of Legendre polynomials
Chapter 8 Sections.44 and 45

UNIT V

Bessel functions and Gamma functions-Properties of Bessel Functions.
Chapter 8 Sections 46 and 47

Contents and treatment as in

"Differential equations with Applications and Historical Notes "by George .Simmons, Second Edition, Tata Mcgraw Hill Publications.

Reference:

1. Differential Equations by D.Raisinghania.
2. Differential Equations by Ganesh C.Gorian.

e- Resources:

1. https://dlmf.nist.gov/.
2. https://Specialfunctionswiki.org.

Title of the Course		MACHINE LEARNING USING R					
Paper Number		Elective					
Category	Elective	Year / Semester	III / VI	Credits	3	Course Code	

Course objectives

- To understand the need for machine learning for various problem solving
- To understand the latest trends in machine learning

To design appropriate machine learning algorithms for problem solving

Course outcomes: At the end of the course, students will be able to

CO1	Differentiate various learning approaches, and to interpret the concepts of supervised learning, unsupervised learning
CO2	Understand Bayesian Decision theory and Multivariate Method
CO3	Apply Clustering & Regression techniques
CO4	Understand Neural Networks and Multilayer Perceptrons
CO5	Understand local models, Assessing and Comparing Classification Algorithms

CONTENTS OF MODULE
UNIT 1: INTRODUCTION TO MACHINE LEARNING Machine learning – examples of machine learning applications – Learning associations – Classification – Regression Unsupervised learning – Supervised learning- Learning class from examples- PAC learning – Noise, model selection and generalization – Dimension of supervised machine learning algorithm.
UNIT-II: DECISION THEORY Bayesian Decision theory – Introduction – Classification – Discriminant function – Bayesian networks -Association rule - Parametric Methods – Introduction – Estimation -Classification - Regression – Multivariate Methods – Data Parameter estimation - Classification – Complexity – Features – Dimensionality Reduction – Analysis – Multidimensional scaling – Linear discriminant analysis.
UNIT-III: CLUSTERING & REGRESSION Clustering – Mixture densities – k- means clustering – Supervised Learning after clustering – Hierarchical clustering – Nonparametric Methods – Density estimation – Generalization of multivariate data – Classification – Regression – Smoothing models – Decision Trees – Univariate trees – Multivariate trees – Learning rules from data – Linear Discrimination.
UNIT-IV: MULTILAYER PERCEPTRONS Structure of brain – Neural networks as a parallel processing - Perceptron – Multilayer perceptron – Back propagation- Training procedures – Tuning the network size – Learning time.
UNIT-V: LOCAL MODELS Competitive learning -Adaptive resonance theory – Self organizing map – Basis functions – Learning vector quantization – Assessing and Comparing Classification Algorithms – Combining Multiple Learners – Reinforcement Learning.

Recommended Text:

1. Ethem alpaydin, “Introduction to Machine Learning”, MIT Press,2004.
2. Tom Mitchell, “Machine Learning”, McGraw Hill, 1997.

e-Resources:

https://nptel.ac.in/
http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=10341&mode=toc.

Mapping of Course Outcomes to Program Specific Outcomes

3 – High 2 – Medium

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	3	2	1	1	2
CO2	1	2	2	-	-	2	1	2	3	3
CO3	3	1	2	-	-	1	2	3	1	2
CO4	2	1	1	-	-	2	3	1	2	1
CO5	2	3	2	-	-	1	1	2	1	1

Title of the Course		TROPICAL LINEAR ALGEBRA					
Paper Number		Elective					
Category	Elective	Year	III	Credits	3	Course Code	
		Semester	VI				

Course Objectives

Tropical linear algebra enables students to efficiently describe and deal with complex sets reveal combinatorial aspects of problems and view a class of problems in a new, unconventional way.

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Analyze the properties of curve counting compactifications.
CO2	Abel to find formulations of the local rigidity theorems for curves and hypersurfaces that are amenable to direct application to problems in control theory
CO3	Investigate eigenvalues and eigenvectors in tropical linear algebra. Able to explain the varieties that are parameterized by monomials in linear forms.
CO4	Understand the concepts of generators, basis, column spaces. Differentiate between solvable systems and unsolvable systems.
CO5	Apply the concepts of principle eigen value and eigen spaces.

CONTENTS OF MODULE
Unit – I: Tropical islands Planes, amoebas and their tentacles, Implicitization, curve counting compactifications
Unit – II: Tropical varieties: Hypersurfaces- the fundamental theorem, the structure theorem.
Unit - III: Tropical varieties: Multiplicities and balancing, connectivity and fans, stable intersection.
Unit -IV: Max – linear systems: Bounded mixed integer solution to dual inequalities, the combinatorial method, the algebraic method, subspaces, generators, external and bases, column spaces, unsolvable systems.
Unit- V: Eigen Values and Eigen Vectors: The eigen problem: basic properties, maximum cycle mean is the principle eigen value, principle eigen space, finite eigen vectors, commuting matrices have a common eigen vector.

Contents and treatment as in

1. Introduction to Tropical Geometry by Diane Maclagan, Bernd Sturmfels.
2. Peter Butkovic – Max – linear Systems: Theory and Algorithms, Springer Monographs in Mathematics

Reference Books

Tropical Algebraic Geometry by Itenberg, Ilia, Mikhalkin, Grigory, Shustin, Eugenii Springer.

Mapping of Course Outcomes to Program Outcomes & Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PS02	PS03
CO1	3	2	2	2	2	2	2	3	3	3
CO2	3	3	2	2	2	2	3	3	2	2
CO3	2	3	1	2	2	2	1	3	1	2
CO4	3	3	2	2	2	2	2	2	1	2
CO5	3	2	1	2	2	2	2	3	2	2

1 Low 2 – Medium 3 – High

EXTRA DISCIPLINARY COURSES

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">PREDICTIVE MODELING WITH R (PRACTICALS)</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">E D P</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – 1
Prediction versus interpretation, key ingredients of predictive Models, Terminology.</td></tr>
<tr><td colspan="6">Unit – 2
Data transformations for individual predictors, Data transformations for multiple predictors, Dealing with missing values, Removing predictors, Adding predictors.</td></tr>
<tr><td colspan="6">Unit – 3
Over Fitting Model Tuning- The problem of over fitting- Model tuning – Data splitting- Resampling Techniques.</td></tr>
<tr><td colspan="6">Unit – 4
Quantitative Measures of performance, The variance – Bias Trade off computing. Linear Regression – Partial Least squares.</td></tr>
<tr><td colspan="6">Unit – 5
Basic Regression Trees, Regression Model trees – Rule base models, Bagged trees, Random forests.</td></tr>
<tr><td colspan="2">Contents and treatment as in</td><td colspan="6">1. Applied Predictive Modeling by Max Kuhn-Kjell Johnson, Springer.
2. An introduction to Statistical Learning with Applications in R, Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, Springer.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Trevor Hastie , Robert Tibshirani , Jerome Friedman, Second Edition (Springer Series in Statistics).</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">http://mathworld.wolfram.com.</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NUMERICAL METHODS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">E D P</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">1</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit 1
Interpolation and Approximation: Finite difference- Introduction- forward and backward
difference-Newton’s forward and backward difference formulas for equal intervals- Divided differences- Newton’s divided difference formula- Lagrangian Polynomials for unequal intervals
Chapter 5, Section 5.1, Chapter 6, Section 6.1 to 6.3 and Chapter 8, Section 8.1 to 8.5 and 8.7</td></tr>
<tr><td colspan="6">Unit 2
Numerical Differentiation : Differentiation using Newton’s forward and backward interpolation formulae, Stirling’s formula.

Chapter 9, Section 9.1 to 9.4.</td></tr>
<tr><td colspan="6">Unit 3
Numerical integration by trapezoidal, Romberg’s method- Simpson’s 1/3 and 3/8 rules.
Chapter 9, Section 9.7 to 9.14</td></tr>
<tr><td colspan="6">Unit 4
Taylor series method- Picard’s method - Euler method for first order equation- Modified Euler method-Fourth order Runge – Kutta method for solving first order equations.
Chapter 11, Section 11.1, 11.5 to 11.9, 11.11 to 11.13</td></tr>
<tr><td colspan="6">Unit 5
Numerical solution of ordinary differential equation by finite difference method- Numerical solution of partial differential equations - Elliptic equation, Poisson equation.
Appendix E
Chapter 12, Section12.1, 12.4 and 12.5 to 12.7</td></tr>
<tr><td colspan="2">Contents and treatment as in</td><td colspan="6">“Numerical Methods”,by Dr P.Kandasamy, Dr. K. Thilagavathy and Dr. K. Gunavathi.S.Chand and Company Ltd</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Numerical Methods With Programming in C by T. Veerarajan and T. Ramachandran.
2. Introductory Methods of Numerical Analysis by S.S.Sastry.</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">1. https://nptel.ac.in.
2. https://mathonline.wikidot.com</td></tr>
</table>

Title of the Course		MATHEMATICS FOR COMPETITIVE EXAMINATIONS & GENERAL STUDIES					
Paper Number		ED					
Category	Extra Disciplinary	Year / Semester	II / III	Credits	1	Course Code	

Objectives of the Course	• Develop problem-solving skills for competitive examinations • Understand the concepts of averages, simple interest, compound interest, time and work, profit and loss, and problems on numbers • Apply mathematical concepts to solve problems related to competitive examinations
Course Outline	**UNIT-I:** Simplifications - Averages – concepts – problems
	UNIT-II: Simple Interest - Compound interest – concepts – problems
	UNIT-III: Time and work - short cuts – concepts – problems
	UNIT – IV: Profit and Loss - short cuts – concepts - problems
	UNIT-V: Problems on numbers - short cuts – concepts - problems

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	**Total Hours: 30** Questions related to the above topics, from various competitive examinations UPSC / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Text	"Quantitative Aptitude" by R.S.Aggarwal, S.Chand& Company Ltd., Ram Nagar, New Delhi (2007)
Reference Books	U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications, 2016. Dr.M.Manoharan, Dr.C.Elango and Prof K.L.Eswaran, Business Mathematics, Palani paramount Publications, Reprint 2013
Website and e-Learning Source	https://tamilnaducareerservices.tn.gov.in/

VALUE ADDED COURSE

LATEX

Unit-1:The Basics- Document class – Page style – Page numbering – Formatting lengths –Parts of a document – Dividing the document –Bibliography.

Unit-2: The BIBTEX program – BIBTEX style files –Creating a bibliographic database -Table of contents, Index and Glossary**.**

Unit-3: Keeping tabs - Tables .Floats-Cross References In Latex.
Typesetting Mathematics- The basics - Custom commands - More on mathematics.

Unit-4: New operators –Symbols -Theorems in LATEX–Designer theorems, Several kinds of boxes. Footnotes, Marginpars, and Endnotes.

Unit-5: Creating a simple document, structuring your document, graphic package Downloading and installingpackages, common errors.

Reference Books

LATEX: A document preparation system (2nd edition) by Leslie.
2.A beginner.s introduction to typesetting with LATEX Peter Flynn.
1. LATEX for Complete Novices Version 1.4 Nicola L. C. Talbot

e-Resources:

https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf
https://www.dickimaw-books.com/latex/novices/novices-report.pdf

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">DATA ANALYTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">VAC</td><td>Year</td><td></td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td></td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – 1
Descriptive Statistics Introduction to the course Descriptive Statistics Probability Distributions, Inferential Statistics Inferential Statistics throughhypothesis tests Permutation & Randomization Test.</td></tr>
<tr><td colspan="6">Unit -2
Regression & ANOVA Regression ANOVA(Analysis of Variance, MachineLearning: Introduction and Concepts Differentiating algorithmic and model based frameworks.</td></tr>
<tr><td colspan="6">Unit – 3
Regression : Ordinary Least Squares, Ridge Regression, Lasso Regression,K Nearest Neighbours Regression & Classification.</td></tr>
<tr><td colspan="6">Unit – 4
Supervised Learning with Regression and Classification techniques - 1 Bias-Variance Dichotomy Model Validation Approaches Logistic Regression Linear DiscriminantAnalysis Quadratic DiscriminantAnalysis Regression and Classification Trees Support Vector Machines.</td></tr>
<tr><td colspan="6">Unit –5
Prescriptive analytics Creating data for analytics through designed experiments Creating data for analytics through Active learning Creatingdata for analytics through Reinforcement learning.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010</td></tr>
</table>

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">NEURAL NETWORKS AND ALGORITHM</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">VAC</td><td>Year</td><td></td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td></td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">UNIT – I
Introduction to Artificial Intelligence System: Neural Network, Fuzzy logic, Genetic Algorithm. Fundamentals of Neural Networks: What is Neural Network, Model of Artificial Neuron, Learning rules and various activation functions</td></tr>
<tr><td colspan="6">UNIT – II
Neural Network Architecture: Single layer Feed-forward networks. Multilayer Feed-forward networks. Recurrent Networks.</td></tr>
<tr><td colspan="6">UNIT – III
Back propagation Networks: Back Propagation networks, Architecture of Back-propagation(BP) Networks, Back-propagation Learning, Variation ofStandard Back propagation algorithms.</td></tr>
<tr><td colspan="6">UNIT – IV
Adaptive Resonance Theory: Cluster Structure, Vector Quantization, Classical ART Network, Simplified ART Architecture,ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data</td></tr>
<tr><td colspan="6">UNIT – V
Introduction about Fuzzy set theory: Fuzzy versus Crisp, Crisp and fuzzy sets, Crisp and Fuzzy relations. Integration of Neural Network, Fuzzy logic and Genetic Algorithm: Hybrid system. Neural Networks, Fuzzy logic, and Genetic Algorithm Hybrids.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
2. Neural Networks, Fuzzy Logic and Genetic Algorithms, by S.Rajasekaran and G.A.
Vijayalakshmi Pai.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Build_Neural_Network With MS Excel sample by Joe choong.</td></tr>
</table>

Other Department
Allied Papers

ALLIED PAPERS

B.COM

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">BUSINESS MATHEMATICS - I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit - 1

Set Theory – Definition, Elements and Types of Sets, Operations on Sets, Relations and Functions of Sets
Chapter -1</td></tr>
<tr><td colspan="6">Unit – 2

Ratio, Proportion and Variations
Chapter – 2,3</td></tr>
<tr><td colspan="6">Unit – 3

Permutation and Combination, Binominal Theorem, Exponential and Logarithmic Series
Chapter – 8, 9 ,10</td></tr>
<tr><td colspan="6">Unit – 4

Differential Calculus: Differentiation – Meaning -, Rules: Maxima and Minima of Univariate Functions: Application of Maxima and Minima in Business
Chapter -13 (Pg. no: 434 – 526)</td></tr>
<tr><td colspan="6">Unit – 5

Interest and Annuity – Banker’s Discount

Chapter – 11, 19.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Business Mathematics – P.R. Vittal, Margham Publication, Reprint 2014.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1.Business Mathematics – D.C. Sancheti and V.K. Kapoor
2.Business Mathematics – B.M. Agarwal
3.Business Mathematics – R.S. Soni</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">1. http://mathworld.wolfram.com
2. http://www.aanalyzemath.com/calculus</td></tr>
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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">BUSINESS MATHEMATICS – II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit - 1
Plane Analytical Geometry: - Cartesian coordinate system: Length of a Line Segment – Section Formulae (Ratio) – Gradient of a Straight Line – Equations of a Straight Line.
Chapter – 12 (Pg.No 315 – 367)</td></tr>
<tr><td colspan="6">Unit – 2
Arithmetic, Geometric and Harmonic Progressions

Chapter - 7</td></tr>
<tr><td colspan="6">Unit – 3
Integral Calculus: Integration, Meaning and Rules of Integration – Integration by Substitution and by Parts – Indefinite and Definite Integration – Application in Business
(Trigonometric Functions to be excluded)
Chapter – 13 (Pg.No : 535 – 594)</td></tr>
<tr><td colspan="6">Unit – 4
Interpolation: Binomial, Newton and Lagrange’s Method
Chapter - 22</td></tr>
<tr><td colspan="6">Unit – 5

Matrices – Meaning and Operations – Matrix inversion – Solutions to Linear Equations

Chapter – 14.</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Business Mathematics – P.R. Vittal, Margham Publication, Reprint 2014.</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1.Business Mathematics – D.C. Sancheti and V.K. Kapoor
2.Business Mathematics – B.M. Agarwal
3.Business Mathematics – A.P. Varma
4.Business Mathematics – R.S. Soni</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">1. http://mathworld.wolfram.com
2. http://www.univie.ac.at/future.media/moe/galerie.html</td></tr>
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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">BUSINESS STATISTICS AND OPERATIONS RESEARCH – I</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>III</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – 1
Introduction – Classification and tabulation of statistical data – Diagrammatic and graphical representation of data.

Chapter 1, 2, 3, 4</td></tr>
<tr><td colspan="6">Unit – 2
Measures of Central tendency – Mean, median and mode – Dispersion, Range, Quartile Deviation, Mean Deviation , Standard Deviation – Measures of Skewness.
Chapter 5, 6</td></tr>
<tr><td colspan="6">Unit – 3
Correlation – Karl Pearson’s Coefficient of Correlation – Spearman’s Rank Correlation-Regression Lines and Coefficients.
Chapter 8, 9</td></tr>
<tr><td colspan="6">Unit – 4
Introduction to OR–Linear Programming Formulation–Graphical and Simplex method to solve LPP with all constraints of less than or equal to type only (Simple Problems only)

Chapter 15</td></tr>
<tr><td colspan="6">Unit – 5
Network Analysis – PERT and CPM (no crashing)

Chapter 24</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Dr. P.R.Vittal,Business Statistics and Operations Research,Margham publications</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Dr.S.P.Rajagopalan ,R.Sattanthan, Business Statistics & Operations Research, Margham Publications.
2. Dr.S.P.Gupta, Statistical Methods
3. Gupta and Hira, Operations Research, S.Chand.
4. Handy and A.Taha, Operations Research, Macmillan Publishers</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">http://nptel.ac.in</td></tr>
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<tr><td colspan="2">Title of the Course</td><td colspan="6">BUSINESS STATISTICS AND OPERATIONS RESEARCH – II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">IV</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit - 1
Time Series Analysis – Trend – Seasonal Variation – Cyclical variations.
Chapter 12</td></tr>
<tr><td colspan="6">Unit – 2
Index Numbers – Aggregative and Relative Index – Chain and Fixed Index – Wholesale Index – Cost of Living Index.

Chapter 13</td></tr>
<tr><td colspan="6">Unit – 3
Probability – Addition and Multiplication Theorem – Conditional probability – Baye’s Theorem (without proof) – Simple problems.

Chapter 14</td></tr>
<tr><td colspan="6">Unit – 4
Assignment and Transportation Problems.

Chapter 16 , 17</td></tr>
<tr><td colspan="6">Unit – 5
Game Theory - Games with saddle – Dominance – Graphical Method.
Chapter 15 (Book 2)</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">1. Dr. P.R.Vittal,Business Statistics and Operations Research,Margham publications

2. Dr. P. R. Vittal, V. Malini, Operations Research, Margham publications (Unit – V)</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. Dr.S.P.Rajagopalan ,R.Sattanthan, Business Statistics & Operations Research, Margham Publications.
2. Dr.S.P.Gupta, Statistical Methods
3. Gupta and Hira, Operations Research, S.Chand.
4. Handy and A.Taha, Operations Research, Macmillan Publishers</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">http://nptel.ac.in</td></tr>
</table>

Title of the Course		ALLIED MATHEMATICS-I					
Paper Number		I					
Category	Allied	Year	I	Credits	5	Course Code	
		Semester	I				
Objectives of the Course .		• Students gain knowledge about the basic concepts of Algebra, Theory of Equations. • They also gain the basic knowledge in Matrices, Trigonometry and Differential Calculus.					
Course Outline		**Unit – 1** Algebra and Numerical Methods: Algebra: Summation of series - simple problems. Numerical Methods: Operators E, Δ,∇ difference tables- Newton-Raphson method- Newton's forward and backward interpolation formulae for equal intervals, Lagrange's interpolation formula. Chapter 2, Section 2.1.3, 2.2, 2.2.1, 2.3, 2.3.3 Chapter 3, Section 3.4.1 and Chapter 5, Section 5.1 and 5.2.					
		Unit – 2 Matrices: Symmetric, Skew-Symmetric, Orthogonal, Hermitian, Skew-Hermitian and Unitary matrices. Eigen values and Eigen-vectors, Cayley-Hamilton theorem (without proof) – verification- Computation of inverse of matrix using Cayley - Hamilton theorem. Chapter 4, Section 4.1.1 to 4.1.6, 4.5, 4.5.2, 4.5.3.					
		Unit – 3 Theory of Equations: Polynomial equations with real coefficients, irrational roots, complex roots, symmetric functions of roots, transformation of equation by increasing or decreasing roots by a constant, reciprocal equation-simple problem. Chapter 3, Section 3.1 to 3.4.1					
		Unit – 4 Trigonometry: Expansions of $\sin(n\theta)$ and $\cos(n\theta)$ in a series of powers of $\sin\theta$ and $\cos\theta$ - Expansions of $\sin^n\theta$, $\cos^n\theta$, $\tan^n\theta$ in a series of sines, cosines and tangents of multiples of "θ" - Expansions of $\sin\theta$, $\cos\theta$ and $\tan\theta$ in a series of powers of "θ" – Hyperbolic and inverse hyperbolic functions. Chapter 6, Section 6.1 to 6.3.					
		Unit – 5 Differential Calculus: Successive differentiation, nth derivatives, Leibnitz theorem (without proof) and applications, Jacobians, Curvature and radius of curvature in Cartesian co-ordinates, maxima and minima of functions of two variables- Simple problems Chapter 1, Section 1.1 to 1.3.1 and 1.4.3. .					
Contents and treatment as in		Allied Mathematics, Volume I and II, by P. Duraipandian and S. Udayabaskaran, S. Chand Publications					

Reference Books	1. S. Narayanan and T.K. Manickavasagam Pillai – Ancillary Mathematics, S. Viswanathan Printers, 1986, Chennai. 2. Allied Mathematics by Dr. A. Singaravelu, Meenakshi Agency.
e-Resources:	1. http://www.themathpaage.com 2. http://nptel.ac.in

Course outcomes: At the end of the course, students will be able to

CO1	Understand the concepts of Summation of Series
CO2	Understand the concepts of Cayley Hamilton Theorem and inverse matrices
CO3	Understand the concepts of teor of eqations
CO4	Understand the knowledge about expansions, hyperbolic and inverse hyperbolic functions
CO5	Understand the concept of Leibnitz theorem and functions of two variables

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	**1**	2	2	2	1	2	2
CO2	2	2	1	**2**	2	1	1	1	2	2
CO3	3	2	1	**1**	2	1	2	2	3	2
CO4	2	2	1	**1**	3	2	2	2	2	3
CO5	3	2	2	**1**	2	2	2	2	2	2

3 – High **2 – Medium** **1 – Low**

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ALLIED MATHEMATICS-II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">II</td></tr>
<tr><td>Category</td><td>Allied</td><td>Year
Semester</td><td>I
II</td><td>Credits</td><td>5</td><td>Course Code</td><td></td></tr>
<tr><td colspan="2">Objectives of the Course</td><td colspan="6">• Students gain some knowledge in Integral Calculus, Differential Equations.
• They also learn the basic concepts in Laplace Transforms and Vector Calculus</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – 1
Integral Calculus: Bernoulli’s formula – Reduction formulae- $\int_0^{\pi/2} Sin^n x dx$, $\int_0^{\pi/2} Cos^n x dx$, $\int_0^{\pi/2} \sin^m x Cos^n x dx$ (m, n being positive integers), Fourier series for functions in (0, 2π),(-π, π).
Chapter 2: Section 2.7 & 2.9,
Chapter 4: Section 4.1.</td></tr>
<tr><td colspan="6">Unit – 2
Differential Equations:
Ordinary Differential Equations: second order non- homogeneous differential equations with constant coefficients of the form ay” +by’+ cy = X where X is of the form $e^{\alpha x} \cos \beta x$ and $e^{\alpha x} \sin \beta x$ -Related problems only.
Partial Differential Equations: Formation, complete integrals and general integrals, four standard types and solving Lagrange's linear equation P p +Q q= R.
Chapter 5: Section 5.2.1, Chapter 6: Section 6.1 to 6.4</td></tr>
<tr><td colspan="6">Unit – 3
Laplace Transforms: Laplace transformations of standard functions and simple properties, inverse Laplace transforms, Application to solution of linear differential equations up to second order- simple problems.
Chapter 7: Section 7.1.1 to 7.1.4& 7.2 to 7.3</td></tr>
<tr><td colspan="6">Unit – 4
Vector Differentiation: Introduction, Scalar point functions, Vector point functions, Vector differential operator Gradient, Divergence, Curl, Solenoidal, Irrotational, identities.
Chapter 8, Section 8.1 to 8.4.4</td></tr>
<tr><td colspan="6">Unit – 5
Vector Integration: Line, surface and volume integrals, Gauss, Stoke's and Green's theorems (without proofs). Simple problems on these.
Chapter 8, Section 8.5 to 8.6.3.</td></tr>
<tr><td colspan="2">Contents and treatment as in</td><td colspan="6">Allied Mathematics, Volume I and II, P. Duraipandian and S. Udayabaskaran, S. Chand Publications.</td></tr>
</table>

Reference Books	1. S. Narayanan and T.K. Manickavasagam Pillai – Ancillary Mathematics, S. Viswanathan Printers, 1986, Chennai. 2. Allied Mathematics by Dr. A. Singaravelu, Meenakshi Agency.
e-Resources:	1. http://www.sosmath.com 2. http://www.analyzemath.com/Differential_Equations/applications.htm

Course outcomes: At the end of the course, students will be able to

CO1	Understand the concepts of integral calculus
CO2	Understand the concepts of Non-Homogenous and Partial Differential Equations
CO3	Understand the Laplace Transform
CO4	Understand the concepts of Vector Differentiation
CO5	Understand the concepts of Vector Integration

Mapping of Course Outcomes to Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	**1**	2	2	2	1	2	2
CO2	2	2	1	**2**	2	1	1	1	2	2
CO3	3	2	1	**1**	2	1	2	2	3	2
CO4	2	2	1	**1**	3	2	2	2	2	3
CO5	3	2	2	**1**	2	2	2	2	2	2

3 – High 2 – Medium 1 – Low

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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">ADVANCED STATISTICS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">I</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – 1
Probability and Theoretical Distributions
Probability –Definition - addition theorem -Multiplication theorem-conditional probability -Baye's theorem– simple problems
Theoretical Distributions- Binomial ,Poisson and Normal distributions-simple problems.</td></tr>
<tr><td colspan="6">Unit – 2
Statistical Inference-Testing of Hypothesis for large samples Testing of hypothesis- procedure-two types of error- one and two tailed tests - standard error - large sample — test for specified proportion –tes for difference between proportions-test for specified mean –test fo difference of mean of two samples.</td></tr>
<tr><td colspan="6">Unit – 3
Testing of Hypothesis for Small samples
Small samples: t-test: specified mean, equality of two means- paired t-test, F-test -equality of variances- Chi square test - independence of attributes and goodness of fit.</td></tr>
<tr><td colspan="6">Unit – 4
Analysis of Variance and Decision Theory
Analysis of variance-one way and two-way classification- Pay off table-Maximin principle - Minimax principle - Baye’s Principle-Decision tree Analysis</td></tr>
<tr><td colspan="6">Unit – 5
Correlation and Regression
Correlation-types of Correlation-Karl Pearson’s Coefficient of correlation - Rank correlation Coefficient-Regression - Regression equations- partial and multiple correlation (upto three variables)-partial and multiple regressions (upto three variables).</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">1. S.P. Gupta, Statistical Methods, Sultan Chand, 2005.
2. P.R. Vittal, Quantitative Techniques, Margham Publications.</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">http://nptel.ac.in</td></tr>
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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="6">RESOURCE MANAGEMENT TECHNIQUE</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="6">II</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="5">Course Outline</td><td colspan="6">Unit – 1
Transportation model- Balanced and Unbalanced Transportation problems-Initial basic feasible solution - North west corner rule , the row minima ,column minima, least cost method and Vogel’s approximation methods – Optimum solution – Modi method.
Chapter 7 -7.1 to 7.5</td></tr>
<tr><td colspan="6">Unit – 2
Assignment Problem- Balanced and Unbalanced – Minimization and Maximization - restricted assignment problem - travelling salesman problem . Sequencing problem: - Processing of n jobs through 2 machines- Processing of n jobs through 3 machines- Processing each of n jobs through m machines - Processing 2 jobs through m machines.
Chapter 8 : 8.1 to 8.8
Chapter 14: 14.1 to 14.7</td></tr>
<tr><td colspan="6">Unit – 3
Game Theory- Pure & Mixed Strategies - Dominance-Graphical method.
Chapter 16: 16.1 to 16.7</td></tr>
<tr><td colspan="6">Unit – 4
Replacement Model1-Model-Replacement of an item whose maintenance cost increases with time and money value is not changed.
Model 2-Replacement of an item whose maintenance cost increases with time and money value is changes with time.
Model 3 - Replacement of items due to sudden Failure - Model 4-Staff replacement.(without proof)
Chapter 11: 11.1 to 11.4</td></tr>
<tr><td colspan="6">Unit – 5
PERT and CPM – Project Network diagram – Critical Path (Crashing Excluded)– PERT computations.

Chapter 15 : 15.1 to 15.6</td></tr>
<tr><td colspan="2">Recommended Text</td><td colspan="6">Sundaresan, Ganapathy Subramanian, Resource Management Technique –A.R.Publications</td></tr>
<tr><td colspan="2">Reference Books</td><td colspan="6">P.R.Vittal & V. Malini, Operations Research, Margham Publications.2007</td></tr>
<tr><td colspan="2">e-Resources:</td><td colspan="6">http://nptel.ac.in</td></tr>
</table>

Non – Major Elective

Course Title: Mathematics for Competitive Examinations-I

Course	NME-I
Exam Hours	

Credits	
CIA Marks	50
ESE Marks	50

CONTENTS OF MODULE
Unit I : Average, Problems on ages
Unit II: Clocks and calendar
Unit III: Profit and Loss
Unit IV: Coding and Decoding test
Unit V: Number, Rank and Order test

Contents and treatment as in :

1. Quantitative Aptitude for Competitive Examinations by Dr. R.S. Aggarwal.
2. S.Chands's Exam success series, General Intelligence and Test of Reasoning, Second Edition.

Unit I	**Chapter 6, 8**
Unit II	**Chapter 27, 28**
Unit III	**Chapter 30**
Unit IV	**Chapter 14, 15 (Book 2)**
Unit V	**Chapter 11 (Book 2)**

Reference Books:

1. Upkar's Verbal Reasoning for Competitive Exams by Dr. Lal & Kumar.

Course Title: Mathematics for Competitive Examinations-II

Course	NME -II
Exam Hours	

Credits	
CIA Marks	50
ESE Marks	50

CONTENTS OF MODULE
Unit I : Time and Distance,
Unit II: Time and Work
Unit III: Problems on Trains, Boats and streams
Unit IV: Blood relation and Family
Unit V: Series and Classification

Contents and treatment as in :

1. Quantitative Aptitude for Competitive Examinations by Dr. R.S. Aggarwal.
2. S.Chands's Exam success series, General Intelligence and Test of Reasoning, Second Edition.

Unit I	**Chapter 17,18**
Unit II	**Chapter 13**
Unit III	**Chapter 20,** **Chapter 26**
Unit IV	**Chapter 18 (Book 2)**
Unit V	**Chapter 1, 3 (Book 2)**

Reference Books:

1. Upkar's Verbal Reasoning for Competitive Exams by Dr. Lal & Kumar.