MANONMANIAM SUNDARANAR UNIVERSITY
Tirunelveli 627012, INDIA
Department of Mathematics

Vision of the University

To provide quality education to reach the un-reached

Mission of the University

- ❖ To conduct research, teaching and outreach programmes to improve conditions of human living
- ❖ To create an academic environment that honours women and men of all races, caste, creed, cultures an atmosphere that values intellectual curiosity, pursuit of knowledge, academic freedom and integrity
- ❖ To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups.
- ❖ To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development
- ❖ To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

Vision of the Department

To attain academic excellence at the international level at par with leading research institutions.

Mission of the Department

To develop mathematical skills, knowledge and critical thinking in the minds of young students.

1. **Name of the Programme** : Integrated M. Sc Mathematics

2. **Preamble of the Programme:** Those who seek admission to Integrated M.Sc. Mathematics Degree programme must have passed the Higher Secondary Examinations (+ 2) conducted by the Board of Higher Secondary Examination, Tamil Nadu with the subjects Mathematics, Physics and Chemistry or an equivalent programme of study with 60% of marks in Mathematics (55% for SC/ST/SCA applicants).

3. **Programme Structures**

Semester	Part	Course Code	Course	Course Nature	Credits	Contact Hours Per Week	Continuous Internal Assessment (CIA)	End Semester Exam (ESE)
I	1		Tamil / Other Language	Language	4	4	25	75
	2		English	Language	4	4	25	75
	3		Theory of Equations	Core	4	4	25	75
	3		Differential Calculus	Core	4	4	25	75
	3		Physics – I	Allied	3	3	25	75
	3		Practical	Allied	2	4	50	50`
	3		Professional English - I	Core	4	4	25	75
	4		Environmental Studies	Common	2	2	25	75
II	1		Tamil / Other Language	Language	4	4	25	75
	2		English	Language	4	4	25	75
	3		Analytical Geometry	Core	4	4	25	75
	3		Vector Calculus	Core	4	4	25	75
	3		Physics – II	Allied	3	3	25	75
	3		Physics – II Practical	Allied	2	4	50	50
	3		Professional English - II	Core	4	4	25	75
	4		Value Based Education / Social Harmony	Common	2	2	25	75
III	1		Tamil / Other Language	Language	4	4	25	75
	2		English	Language	4	4	25	75
	3		Real Analysis	Core	4	4	25	75
	3		Chemistry – I	Allied	3	3	25	75
	3		Practical	Allied	2	4	50	50
	3		Programming in C	Skill Based Subject	4	4	25	75
	4		Basic Mathematics	Non-Major Elective	3	3	25	75

	4		Yoga	Mandatory	2	2	25	75
IV	1		Tamil / Other Language	Language	4	4	25	75
	2		English	Language	4	4	25	75
	3		Differential Equations	Core	4	4	25	75
	3		Chemistry – II	Allied	3	3	25	75
	3		Chemistry II- Practical	Allied	2	4	50	50
	3		Latex and MATLAB	Skill Based Subject	4	4	25	75
	4		Discrete Mathematics	Non-Major Elective	3	3	25	75
	4		Computers for digital era	Mandatory	2	2	25	75
	5		NCC/NSS/YRC/YWF	Extension activity	1	2	25	75
V	3		Abstract Algebra	Core	4	4	25	75
	3		Metric Spaces	Core	4	4	25	75
	3		Statics	Core	4	4	25	75
	3		Major Elective-I	Elective	4	4	25	75
	3		Major Elective- II	Elective	4	4	25	75
	4		Personality Development / Effective Communication/ Youth Leadership	Skill Based Subject	2	2	25	75
VI	3		Complex Analysis	Core	4	4	25	75
	3		Linear Algebra	Core	4	4	25	75
	3		Graph Theory	Core	4	4	25	75
	3		Dynamics	Core	4	4	25	75
	3		Major Elective - III	Elective	4	4	25	25
	3		Group Project/Internship training	Project	6	6	50	50
		Total			159	151		

List of Major Elective Papers

1. Elementary Number Theory

2. Statistics - I

3. Statistics – II

4. Numerical Methods

5. Linear Programming

6. Combinatorial Mathematics

7. Coding Theory

8. Operations Research

9. Mathematical Programming Using JAVA

10. Integral transforms and applications

11. Special Functions

12. Mathematical Logic

13. Astronomy

4. Scheme of Evaluation:

Each course is for 100 marks with Internal 25 marks and External 75 marks.

For Semesters I – VI, the internal assessment comprises of 2 components – 20 marks for written test (average of the best two of 3 tests) and 5 marks for Assignment.

For Semesters VII – X, the internal assessment comprises of 3 components -15 marks for written test (average of the best two of 3 tests), 5 marks for Seminar and 5 marks for Assignment.

The Question paper pattern for end semester examination is as follows:

Section A - 10 x 1 = 10 (Objective type questions)
Section B - 5 x 5 = 25 (Internal choice questions)
Section C - 5 x 8 = 40 (Internal choice questions)

The duration of the examination is 3 hours. Passing minimum in the external examination is 50% (that is 38 out of 75). Passing minimum in the aggregate (internal and external marks put together) 50 % (that is 50 out of 100). No passing minimum for the internal examinations.

Examination, evaluation and classification will be made as per the rules and regulations of the University in force.

5. Programme Outcomes*(POs):

On the successful completion of the Bachelor of Science Programme in Mathematics students will be able to

PO 1	develop deep interest in learning Mathematics.
PO 2	adapt logical reasoning and critical thinking , become familiar with enough number of subjects including application oriented ones to suit the present needs of various allied branches in Basic Sciences, Applied Sciences and Engineering.
PO 3	apply Mathematical skills in interdisciplinary areas such as Computer Science, Actuarial Science, Social Sciences and other areas of inquiry so that they can pursue their future career either in the core field or in the applied field.
PO 4	develop analytic and problem solving skills for careers
PO 5	Retell the definitions, concepts, principles and theorems by the deep knowledge and understanding gained.
PO 6	paraphrase various concepts of Mathematics effectively using examples and their geometrical visualizations.
PO 7	explain independently and perform in-depth study of various notions of Mathematics.
PO 8	estimate their skills and proceed to undertake further studies in Mathematics and its allied areas.

K1-Remembering	K2-Understanding	K3-Applying	K4-Analyzing	K5-Evaluating	K6-Creating
PO5	PO6	PO3	PO7	PO8	PO1, PO2, PO4

6. Programme Specific Outcomes (PSOs):

On the successful completion of the Bachelor of Science Programme in Mathematics students will be able to

PSO 1	appreciate the emphasis given on teaching the fundamentals, the basic concepts, definitions with a variety of examples.
PSO 2	adapt the skill to facilitate with abstract reasoning and inculcate the habit of self-learning.
PSO 3	create a positive attitude towards Mathematics as an interesting and valuable subject of study.
PSO 4	define all the arithmetic, algebraic, analytic and geometric concepts.
PSO 5	promote logical reasoning, critical thinking and summarize with in-depth knowledge of Algebra, Calculus, Geometry, Differential Equations and several other branches of Mathematics.
PSO 6	develop analytic and problem solving skills and getting acquainted with computational Techniques.
PSO 7	present Mathematical ideas clearly , precisely and explain fundamental concepts of Mathematics to non-mathematicians
PSO 8	formulate a solid foundation for higher studies in Mathematics

Course Description

Semester	Course Code	Title of the Course	Category	Hours/Week	L	T	P	C
I		**THEORY OF EQUATIONS**	Core	4	3	1	-	4

Course Objectives:

1. The course aims to discuss various methods in theory of equations to solve algebraic and transcendental equations.
2. To understand the relation between the roots and the coefficients of polynomial equations so as to deduce r^{th} powers of roots
3. To learn different techniques and methodologies to find solution of equations.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Describe the relation between roots and coefficients	**K1 & K2**
CO2	Find the sum of the power of the roots of an equation using Newton's Method.	**K5**
CO3	Transform the equation through roots multiplied by a given number, increase the roots, decrease the roots, removal of terms	**K6**
CO4	Analyse the location and describe the nature of the roots of an equation.	**K4**
CO5	Compute a real root of an equation by Cardan's method.	**K2 & K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Theory of equations: Remainder theorem – imaginary roots – irrational roots – relations   roots and coefficients.   (12 hours)

Unit II: Symmetric function of the roots - Sum of the powers of the roots – Newton's theorem.   (12 hours)

Unit III: Transformations of equations – Transformations of equations in general. (12 hours)

Unit IV: Reciprocal equations – Descarte's rule of signs –Rolle's Theorem – multiple roots.   (12 hours)

Unit V: The Cubic equation – Cardan's method - The Biquadratic equation – Ferrari's method.   (12 hours)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	2	3	3	2.75
CO2	3	3	3	3	2	2	3	3	2.75
CO3	3	3	3	3	2	2	3	3	2.75
CO4	3	3	3	3	2	2	3	3	2.75
CO5	3	3	3	3	2	2	3	3	2.75

PSO \ CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	2	3	3	2.88
CO2	3	3	3	3	3	2	3	3	2.88
CO3	3	3	3	3	3	2	3	3	2.88
CO4	3	3	3	3	3	2	3	3	2.88
CO5	3	3	3	3	3	2	3	3	2.88
Mean Overall Score									2.81 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Books:

1. **T. K. Manicavachagom Pillai, T. Natarajan and K. S. Ganapathy**, Algebra (Volume I), S. Viswanathan Printers and Publishers Pvt. Ltd. 2008

> Unit I: Chapter 6 - Sections 1 to 12,
> Unit II: Chapter 6 – Sections 13 to 15
> Unit III: Chapter 6 – Sections 16, 24, 25, 26

2. **S. Arumugam and A. Thangapandi Isaac**, Set Theory, Number System and Theory of Equations, New Gamma Publishing House, 1992

> Unit IV: Chapter 5 –Sections 5.4, 5.6 and 5.7
> Unit V: Chapter 5 – Sections 5.8 and 5.9

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, Theory of Equations, Theory of Numbers and Trigonometry, New Gamma Publishing House, 2011.
2. P. R. Vittal& V. Malini, Algebra and Trigonometry, Volume I &II, Margham Publishers, 2013.
3. Leonard Eugene Dickson, First Course in the Theory Of Equations, Merchant Books, 2009.

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
I		**CALCULUS**	Core	4	3	1	-	4

Course Objectives:

1. To develop deep knowledge on the derivative and its geometric applications.
2. To make use of Derivative knowledge to sketch the given curves
3. To provide fair introduction to the integrability both in geometrically and analytically and some of its properties.

Course Outcomes (COs):

On completion of this course, the Students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Demonstrate the notion of derivative both in geometrically and analytically. Understand the properties of derivatives	**K2**
CO2	Compute the evolute and involute of the given curve and form the pedal equation of the given curve	**K3**
CO3	Estimate the linear asymptotes and sketch the curves using derivative technique	**K5**
CO4	Explain the notion of integration and its properties	**K5**
CO5	Develop few techniques to find the values of definite integrals	**K6**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Introduction to Differentiation – Mean Value Theorem- Properties of Derivatives-Radius of curvature in Cartesian, Parametric and Polar co-ordinates.

Unit II: Evolutes and Involutes – Pedal Equations.

Unit III: Linear Asymptotes – Curve Tracing.

Unit IV: Introduction to Integration – Methods of Integration – Integration by parts.

Unit V: Properties of Definite Integrals – Reduction formula for standard integrals.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	3	3	3	3	3.00
CO2	3	2	3	3	3	3	3	3	2.87
CO3	3	2	3	3	3	3	3	3	2.87
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3.00
CO2	3	3	3	3	3	3	3	3	3.00
CO3	3	3	3	3	3	3	3	3	3.00
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00
Mean Overall Score									2.81 High

Text Books:

1. S. Narayanan and T.K. Manicavachagom Pillay, Calculus Vol. I, S.Viswanathan Printers and Publishers Pvt. Ltd., 2010,

2. Arumugam and Issac, Calculus, New Gamma Publications, 2005

Reference Books:

1. N. Piskunov, Differential and Integral Calculus, MIR Publications, 1996

2. Shanti Narayan and P.K. Mittal, Differential Calculus, S. Chand Publications, 2007

3. Shanti Narayan and P.K. Mittal, Integral Calculus, S. Chand Publications, 2007

Webliography:

1. https://nptel.ac.in/courses/111/106/111106146/

2. https://nptel.ac.in/courses/109/104/109104124/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
I		**PROFESSIONAL ENGLISH -I**	Core	2	1	1	-	2

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[Part-III -add on Course]

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Course Objectives:

1. To develop the language skills of students by offering adequate practice in professional contexts.
2. To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
3. To focus on developing students' knowledge of domain specific registers and the required language skills.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Recognise their own ability to improve their own competence in using the language	**K1**
CO2	Administer language for speaking with confidence in an intelligible and acceptable manner	**K3**
CO3	Express the importance of reading for life	**K2**
CO4	Read independently unfamiliar texts with comprehension	**K1**
CO5	Write simple sentences without committing error of spelling or grammar	**K6**

Course Outline:

UNIT 1: COMMUNICATION

Listening: Listening to audio text and answering questions
- Listening to Instructions

Speaking: Pair work and small group work.

Reading: Comprehension passages –Differentiate between facts and opinion

Writing: Developing a story with pictures**.**

Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 2: DESCRIPTION

Listening: Listening to process description.-Drawing a flow chart.

Speaking: Role play (formal context)

Reading: Skimming/Scanning-

Reading passages on products, equipment and gadgets.

Writing: Process Description –Compare and Contrast
Paragraph-Sentence Definition and Extended definition-
Free Writing.

Vocabulary: specific -Incorporated into the LSRW tasks.

UNIT 3: NEGOTIATION STRATEGIES

Listening: Listening to interviews of specialists / Inventors in fields
(Subject specific)

Speaking: Brainstorming.(Mind mapping).
Small group discussions (Subject- Specific)

Reading: Longer Reading text.

Writing: Essay Writing (250 words)

Vocabulary: Register specific - Incorporated into the LSRW tasks

UNIT 4: PRESENTATION SKILLS

Listening: Listening to lectures.

Speaking: Short talks.

Reading: Reading Comprehension passages

Writing: Writing Recommendations
Interpreting Visuals inputs

Vocabulary: Register specific -Incorporated into the LSRW tasks

UNIT 5: CRITICAL THINKING SKILLS

Listening: Listening comprehension- Listening for information.

Speaking: Making presentations (with PPT- practice).

Reading: Comprehension passages –Note making.
Comprehension: Motivational article on Professional Competence,
Professional Ethics and Life Skills)

Writing: Problem and Solution essay– Creative writing –Summary writing

Vocabulary: Register specific - Incorporated into the LSRW tasks

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	2	1	3	1	2	3	2.25
CO2	3	3	3	1	3	1	2	3	2.38
CO3	3	3	2	1	3	1	2	3	2.25
CO4	3	3	2	1	3	1	2	3	2.25
CO5	3	3	2	1	3	1	2	3	2.25

PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean

CO								Score
CO1	3	3	3	3	3	1	2	3	2.63
CO2	3	2	3	3	3	1	2	3	2.50
CO3	3	2	3	3	3	1	2	3	2.50
CO4	3	3	3	3	3	1	2	3	2.63
CO5	3	2	3	3	3	1	2	3	2.50
Mean overall score								2.41 **High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book: PDF given by TANSCHE

Reference Books:

      1. Michael Swan, Practical English Usage, Oxford Press.

      2. Martin Hewings, Advanced Grammar in use, Cambridge press

      3. Norman Lewis, Word power made easy, Goyal Reprint edition.

Webliography:

      https://spenglish.me>books-to-learn-english

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
II		**ANALYTICAL GEOMETRY**	Core	4	3	1		4

Course Objectives:

1. This course was studied many years for its geometric nature and view.
2. It is the foundation of most modern fields of geometry, including algebraic, differential, discrete and computational geometry.
3. Unlike the others, this course simply establishes a correspondence between geometric curves and algebraic equations.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	write equations of lines and planes and identify lines and planes from their equation.	**K4, K5**
CO2	measure the distances between points, lines, planes and find the angle between the planes	**K5**
CO3	classify skew lines, coplanar lines and compute the shortest distance between lines	**K5**
CO4	acquire and apply the knowledge of finding the equation of sphere, cone and cylinder based on their properties	**K2, K3**
CO5	Construct the equation of sphere, cone and cylinder of Various forms and their sections.	**K6**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I:	Direction cosines - direction ratios - equation of planes - standard form - normal form - intercept form	(12 hrs)
Unit II:	Angle between two planes - Lines - symmetrical form. Angle between two planes - image of a point - image of a line	(12 hrs)
Unit III:	Skew lines - shortest distance between two lines - coplanar lines	(12 hrs)
Unit IV:	Sphere - plane section of a sphere - tangent plane - intersection of two spheres -intersection of a plane with sphere	(12 hrs)
Unit V:	Cone and Cylinder	(12 hrs)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	3	3	3	2	2.87
CO2	3	3	3	3	3	3	3	2	2.87
CO3	3	3	3	3	3	3	3	2	2.87
CO4	3	3	3	3	3	3	3	2	2.87
CO5	3	3	3	3	3	3	3	2	2.87

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	2	3	3	3	2.87
CO2	3	3	3	3	2	3	3	3	2.87
CO3	3	3	3	3	2	3	3	3	2.87
CO4	3	3	3	3	2	3	3	3	2.87
CO5	3	3	3	3	2	3	3	3	2.87
Mean Overall Score									2.90 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

1. T.K Manicavachagom Pillay and T. Natarajan, A text book of Analytical Geometry - Part II – Three dimensions, S. Viswanathan Printers and Publishers Pvt. Ltd. - 2008.

   (For Units III, IV and V, Chapters I to IV and Chapter V- Sections 1 to 7)

Reference Books:

1. S. Arumugam and Thangapandi Issac, Analytical Geometry of 3D and Vector Calculus, New Gamma Publishing House, Palayamkottai, 2014.
2. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Addison Wesley (9th Edition), Mass. (Indian Print), 1998.
3. Howard Anton, Calculus with Analytical Geometry, Fourth Edition, John & Wiley, 1993.

Webliography:

https://www.toppr.com/guides/maths/three-dimensional-geometry/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
II		**VECTOR CALCULUS**	Core	4	3	1	-	4

Course Objectives:

1. To extend the notions of derivative and integration to vector valued functions.
2. To introduce Jacobian matrix to solve simple, double and triple integration.
3. To utilize some standard theorems to solve some special integrations called line and surface integrals

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Demonstrate the concept of vector differentiation and solve simple problems	K2
CO2	Explain the geometric meaning of line integral, double and triple integrals	K5
CO3	Discuss Jacobian matrix in detail to solve double and triple integrals	K6
CO4	Explain the concept of line integrals and surface integrals using double and triple integrals	K4
CO5	Solve double and triple integrals using the well-known theorems of Green, Stokes and Gauss	K6
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Vector differentiation - gradient - divergence - curl - solenoidal and irrotational vector -formulae involving gradient, divergence and curl.

Unit II: Vector integration - line integral - double and triple integral.

Unit III: Jacobians - change of variables.

Unit IV: Line and surface integrals

Unit V: Problems using Theorems of Green, Stokes and Gauss.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	3	3	3	3	3.00
CO2	3	3	3	3	3	3	3	3	3.00
CO3	3	3	3	3	3	3	3	3	3.00
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	2	3	3	3	3	2.87
CO2	3	3	3	3	3	3	3	3	3.00
CO3	3	3	3	2	3	3	3	3	2.87
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00
Mean Overall Score									2.95 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A.Thangapandi Isaac, Vector Calculus, New gamma publishing House, 2006

Reference Books:

1. Shanti Narayan & P.K. Mittal, A Textbook of Vector Calculus, S. Chand Publication,1987
2. M. Spiegel, S. Lipschutz, Vector Analysis, Mc Graw Hill Publications, 2017
3. Susan J. Colley, Vector Calculus, Pearson Publishers, 2011

Webliography:

1. https://nptel.ac.in/courses/111/105/111105122/
2. https://nptel.ac.in/courses/111/107/111107108/
3. https://nptel.ac.in/courses/111/104/111104125/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
II		**PROFESSIONAL ENGLISH II**	Core	2	1	1	-	2

[Part-III -add on Course]

Course Objectives:

1. Develop their competence in the use of English with particular reference to the workplace situation.
2. Enhance the creativity of the students, which will enable them to think of innovative ways to solve issues in the workplace.
3. Develop their competence and competitiveness and thereby improve their employability skills.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Take part in interviews with boldness and confidence.	K4
CO2	Administer language for speaking with confidence in an intelligible and acceptable manner	K3
CO3	Adapt easily into the workplace context, having become communicatively competent.	K6
CO4	Read independently unfamiliar texts with comprehension	K1
CO5	Apply to the Research &Development organisations/ sections in companies and offices with winning proposals.	K3

Course Outline:

Unit 1- Communicative Competence (18 hrs)

Listening – Listening to two talks/lectures by specialists on selected subject specific topics - (TED Talks) and answering comprehension exercises (inferential questions)

Speaking: Small group discussions (the discussions could be based on the listening and reading passages- open ended questions

Reading: Two subject-based reading texts followed by comprehension activities/exercises

Writing: Summary writing based on the reading passages.

Grammar and vocabulary exercises/tasks to be designed based on the discourse patterns of the listening and reading texts in the book. This is applicable for all the units.

Unit 2 - Persuasive Communication (18 hrs)

Listening: listening to a product launch- sensitizing learners to the nuances of persuasive communication

Speaking: debates – Just-A Minute Activities

Reading: reading texts on advertisements (on products relevant to the subject areas) and answering inferential questions

Writing: dialogue writing- writing an argumentative /persuasive essay.

Unit 3- Digital Competence (18 hrs)

Listening to interviews (subject related)

Speaking: Interviews with subject specialists (usingvideo conferencing skills)

Creating Vlogs (How to become a vlogger and use vlogging tonurture interests – subject related)

Reading: Selected sample of Web Page (subject area)

Writing: Creating Web Pages

Reading Comprehension: Essay on Digital Competence for Academic and Professional Life.

The essay will address all aspects of digital competence in relation to MS Office and how they can be utilized in relation to work in the subject area

Unit 4 - Creativity and Imagination (18 hrs)

Listening to short (2 to 5 minutes) academic videos (prepared by EMRC/ other MOOC videos on Indian academic sites – E.g. https://www.youtube.com/watch?v=tpvicScuDy0)

Speaking: Making oral presentations through short films – subject based

Reading: Essay on Creativity and Imagination (subject based)

Writing – Basic Script Writing for short films (subject based)

- Creating blogs, flyers and brochures (subject based)
- Poster making – writing slogans/captions(subject based)

Unit 5- Workplace Communication& Basics of Academic Writing (18 hrs)

Speaking: Short academic presentation using PowerPoint

Reading & Writing: Product Profiles, Circulars, Minutes of Meeting.

Writing an introduction, paraphrasing

Punctuation(period, question mark, exclamation point, comma, semicolon, colon, dash, hyphen, parentheses, brackets, braces, apostrophe, quotation marks, and ellipsis)

Capitalization (use of upper case)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO\CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	2	1	3	1	2	3	2.25
CO2	3	3	3	1	3	1	2	3	2.38
CO3	3	3	2	1	3	1	2	3	2.25
CO4	3	3	2	1	3	1	2	3	2.25
CO5	3	3	2	1	3	1	2	3	2.25
PSO\CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	Mean Score
CO1	3	3	3	3	3	1	2	3	2.63
CO2	3	2	3	3	3	1	2	3	2.50
CO3	3	2	3	3	3	1	2	3	2.50
CO4	3	3	3	3	3	1	2	3	2.63
CO5	3	2	3	3	3	1	2	3	2.50
Mean overall score									2.41 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book: PDF given by TANSCHE

Reference Books:

1. Michael Swan, Practical English Usage, Oxford Press.
2. Martin Hewings, Advanced Grammar in Use, Cambridge Press
3. Norman Lewis, Word power made easy, Goyal Reprint edition.

Webliography:

https://spenglish.me>books-to-learn-english

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
III		**REAL ANALYSIS**	**Core**	**4**	**3**	**1**	**-**	**4**

Course Objectives:

1. To introduce one of the most important axioms in Analysis, called LUB axiom, to solve some simple problems.
2. To provide fundamental theorems and results which help to identify the convergence of the given sequence.
3. To develop fair idea on the convergence of series and to establish standard tests to check the convergence of the given series.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the usage of LUB axiom in Analysis with suitable examples	K5
CO2	Elaborate various types of sequences with counter examples	K6
CO3	Construct new convergent sequences with the gained knowledge	K6
CO4	Explain and Apply standard theorems on limits to find the limits of given sequences	K5
CO5	Extend the convergence concept to series	K2
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Bounded sets - upper and lower bounds - LUB axiom - Archimedean property - Density of rational and irrationals - Positive n^{th} root of a positive real number.

Unit II: Sequences - Bounded sequences - monotonic sequences - convergent sequences - divergent and oscillating sequences

Unit III: The algebra of limits. Behaviour of monotonic sequences.

Unit IV: Some theorems on limit - sub sequences - limit points - Cauchy sequences - Cauchy general principle of convergence of sequence

Unit V: Series - infinite series - comparison test - D'Alembert's ratio test - Root test - Cauchy's condensation test.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	-	3	3	3	3	2	3.00
CO2	3	3	-	3	3	3	3	2	3.00
CO3	3	3	-	3	3	3	3	2	3.00
CO4	3	3	-	3	3	3	3	2	3.00
CO5	3	3	-	3	3	3	3	2	3.00

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3.00
CO2	3	3	3	3	3	3	3	3	3.00
CO3	3	3	3	3	3	3	3	3	3.00
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00
Mean Overall Score									**3.00 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A. Thangapandi Isaac, *Sequences and series*, New Gamma Publishing House, 2010.

Reference Books:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis*, Wiley Publication, 2015
2. Ajith Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, 2014
3. Kenneth A. Ross, *Elementry Analysis :Theory of Calculus*, Springer, 2010

Webliography:

1. https://nptel.ac.in/courses/111/106/111106142/
2. https://nptel.ac.in/courses/111/106/111106053/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
III		PROGRAMMING IN C	Core	4	3	-	1	4

Course Objectives:

1. The course is designed to provide complete knowledge of C language with practicals in the computer Lab.
2. It imparts adequate knowledge on the need of programming languages and problem solving techniques
3. It makes the students get acquainted with the concept of structures and pointers in C.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	remember the importance and functioning of C programming	K1
CO2	classify decision making and looping classes and apply them in programming	K2, K3
CO3	Implement the concept of arrays, pointers and structures with ethical coding standards	K3
CO4	develop an in-depth understanding of functional and logical concepts of C Programming	K2
CO5	choose the right data representation formats based on the requirements of the problem	K4, K6
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Constants - variables - Data types - operations and Expressions - **(15 hrs)** managing input and output operations

Unit II : Decision making and branching - Decision making and looping **(15 hrs)**

Unit III : Arrays - Handling of character strings **(10 hrs)**

Unit IV: Structures and unions **(10 hrs)**

Unit V : Pointers **(10 hrs)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	1	3	3	2	2	-	2	2	2.14
CO2	1	3	3	2	2	-	2	2	2.14
CO3	1	3	3	2	2	-	2	2	2.14
CO4	1	3	3	2	2	-	1	2	2.00
CO5	1	3	3	2	2	-	1	2	2.00

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	2	-	2	2	1	-	2.16
CO2	3	3	3	-	2	2	1	-	2.33
CO3	3	3	2	-	2	2	1	-	2.16
CO4	3	3	2	-	1	2	1	-	2.00
CO5	3	3	2	-	1	3	2	-	2.33
Mean Overall Score									2.10 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book : Content and treatment as in

E. Balagurusamy, Programming in ANSI C, IV Edition, TMH Publishing Company, Ltd., 2008.

Unit I to V: Chapters 2 to 7 and 9 to 11.

Reference Books :

1. Y. P. Kanetkar, Let Us C, 15th Edition, BPB Publications, 2012.
2. B. Gottfried and J. Chhabra, Programming with C, 3rd Edition, Tata McGraw-Hill, 2010.
3. H. M.Deitel and P. J. Deitel, C - How to Program, 7th Edition, Prentice-Hall, 2012.

Webliography:

1. https://nptel.ac.in/courses/106/104/106104128/
2. https://nptel.ac.in/courses/106/105/106105171/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
III		**BASIC MATHEMATICS**	Core	4	3	1	-	4

Course Objectives:

1. The main aim of introducing "Quantitative Aptitude" for mathematics students is to develop skill to meet the competitive examinations for better job opportunity.
2. Effort has been made to accommodate fundamental, mathematical aspects to instill confidence among students.
3. Enrich their knowledge and to develop their logical reasoning thinking ability.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Analyze the problems logically and approach the problems in a different manner.	K4
CO2	Define HCF and LCM.	K1
CO3	Explain the significance of the notions of conversion of decimal to vulgar function	K2, K3 & K4
CO4	Solve the problems easily by using short-cut method with time management which will be helpful to them to clear the competitive exams for better job opportunity	K3
CO5	Evaluate the cube root of positive integer using factorization method.	K5
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

UNIT I: Numbers - Face value and place value of a digit in a number - test of divisibility, Applications of algebraic formulae, unit digit - series.   **(10 hours)**

UNIT II: H.C.F. and L.C.M. of numbers - factorization method - common division method, H.C.F. and L.C.M. of decimal fraction - comparison of fractions.   **(10 hours)**

UNIT III: Decimal fraction - conversion of decimal into vulgar fraction-operation son decimal fractions- comparison of fractions-recurring decimal-mixed recurring decimal.

(9 hours)

Unit IV: Simplification - BODMAS Rule - modulus of a real number - vinculum - Some real life problems - missing numbers in the expression.   **(8 hours)**

Unit V: Square root and cube root - finding square root by factorization method- perfect square and perfect cube.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	2	3	3	2.75
CO2	3	3	3	3	2	2	3	3	2.75
CO3	3	3	3	3	2	3	3	3	2.88
CO4	3	3	3	3	2	3	3	3	2.88
CO5	3	3	3	3	2	3	3	3	2.88

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	2	3	3	3	2	2.75
CO2	3	3	3	2	3	3	3	2	2.75
CO3	3	3	3	2	3	3	3	2	2.75
CO4	3	3	3	2	3	3	3	2	2.75
CO5	3	3	3	2	3	3	3	2	2.75
Mean Overall Score									2.79 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

R. S. Aggarwal, Quantitative Aptitude, S. Chand & Co., 2014

Unit I to V: Chapters 1 to 5

Reference Books:

1. Rajesh Verma, Fast Track Objective Arithmetic, Arihant Publications, Fourth edition, 2018.

2. Sarvesh K Verma, Quantitative Aptitude Quantum CAT 2019, 10th Edition, Arihant Publications, 2019.

3. Abhijit Guha, Quantitative Aptitude for All Competitive Examinations, Sixth edition, McGraw Hill Education, 2016.

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
IV		**DIFFERENTIAL EQUATIONS**	Core	4	3	1	-	4

Course Objectives:

1. To provide systematic development to solve first order differential equations.
2. To extend the gained knowledge to solve higher order differential equations with constant or variable co-efficient.
3. To establish the concept of Partial differential equations and to find solutions of some standard type partial differential equations.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Develop various techniques to solve first order first degree differential equations	K6
CO2	Solve Linear Differential Equations with higher order	K6
CO3	Formulate various methods to solve Linear Differential Equations with variable co-efficient.	K5
CO4	Figure out the formulation of Partial Differential Equations and some standard first order PDE	K4
CO5	Solving First Order PDE	K6
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Equation of First Order and First Degree - Variable separable method - Homogeneous equations - non-homogeneous equations - Exact differential equations - Linear equations

Unit II: Linear Equations of Higher Order with Constant Co-efficient - Method of finding Complementary Functions - Particular Integrals

Unit III: Linear Equations with variable co-efficient - The general solution in terms of known integrals of C.F. - Removal of first derivative - The method of variation of parameter - Simultaneous linear differential equations

Unit IV: Formation of PDE - Some standard forms of first order PDE

Unit V: Solving first order PDE - Lagrange's method - Charpit's method

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO\CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	-	3	3	3	3	3	3.00
CO2	3	3	-	3	3	3	3	3	3.00
CO3	3	3	-	3	3	3	3	3	3.00
CO4	3	3	-	3	3	3	3	3	3.00
CO5	3	3	-	3	3	3	3	3	3.00

PSO\CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3.00
CO2	3	3	3	3	3	3	3	3	3.00
CO3	3	3	3	3	3	3	3	3	3.00
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00
Mean Overall Score									**3.00 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and Isaac, *Differential Equations and Applications*, New Gamma Publishing House, 1999.

Unit I: Sections: 1.1 - 1.5
Unit II: Sections: 2.1 - 2.3
Unit III: Sections: 2.4 - 2.5
Unit IV, V: Sections: 4.1 - 4.5

Reference Books:

1. M.D. Raisinghania, Ordinary and Partial Differential Equations (20th Ed), S.Chand& Sons Publications, 2020

2. Richard Bronson, Differential Equations, Mc Graw Hill Publications, 2005

3. Zafar Ahsan – Differential Equations and Their Applications, PHI Publishers, 2016

Webliography:

1. https://nptel.ac.in/courses/111/106/111106100/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
IV		**LATEX AND PYTHON**	Core	4	3	-	1	4

Course Objectives:

1. This course introduces the LaTeX typesetting language to all prospective interested students.
2. It is used for writing all scientific papers and presentations in Mathematics, this knowledge how to use it is essential for all to be professionals.
3. Understand the basic components of computer programming using the Python language. Demonstrate significant experience with the Python program development environment.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Remember to download and install open source software Latex	K1
CO2	Understanding and formatting Latex	K2
CO3	Illustrate to learn to create Latex file	K3
CO4	Apply and Analyze the PYTHON commands to large PYTHON programme	K3 & K4
CO5	Able to learn mathematics derivations and structures using PYTHON	K6
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Document Layout and organization – Document class, Page style, Parts of the document, Text formatting, TeX and its offspring, what's different in latex 2 - Distinguishing LaTeX 2 and basics of LaTeX file. **(12 hours)**

Unit II: Commands and environments-command names and arguments, Environments, Declarations, Lengths, Special characters, Fragile Commands, Exercise. Table of contents, Fine - Tuning text, Word division, Labelling, Referencing, Displayed text – Changing font, Centering and identifying, Lists, Generalized Lists, Theorem like declarations, Tabular stops, Boxes. **(12 hours)**

Unit III: Tables, Printing literal text, Footnotes and marginal notes. Drawing pictures using LaTeX, Mathematical formulas – mathematical environments, Main elements of math mode, Mathematical symbols, Addition elements, Fine – tuning Mathematics. **(12 hours)**

Unit IV: Introduction to Python - Why Python - Installing in various Operating Systems - Executing Python Programs - Basic Programming concepts - Variables, expressions and statements - Input/ Output –Operators. **(12 hours)**

Unit V: Conditions - Functions - Arguments - Return values - Iteration - Loops - Strings - Data Structures - Lists - Dictionaries - Tuples - Sequences - Exception Handling.

(12 hours)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	1	3	3	2	2	2	3	3	2.38
CO2	2	3	3	2	2	2	3	3	2.50
CO3	1	3	3	2	2	2	3	3	2.38
CO4	2	3	3	2	2	2	3	3	2.50
CO5	2	3	3	2	2	2	3	3	2.50

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	1	1	2	1	1	2	1	1	1.25
CO2	2	1	2	1	1	2	1	1	1.38
CO3	2	1	2	1	1	2	1	1	1.38
CO4	2	2	2	1	1	2	1	1	1.50
CO5	2	2	2	1	1	2	1	1	1.50
Mean Overall Score									**1.93 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Books:

1. H. Kopka and P.W. Daly, A Guideline to LaTeX, Third edition, Addison – Wesley, London, 1999.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist (Second Edition), Shroff /O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

Reference Books:

1. John V Guttag, Introduction to Computation and Programming Using Python', Revised and expanded Edition, MIT Press, 2013.
2. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012. L. Lamport, LATEX: A Document Preparation System, User's Guide and Reference Manual, Addison-Wesley, New York, second edition, 1994.
3. Martin J. Erickson and Donald Binder, A Student's Guide to the Study, Practice, and Tools of Modern Mathematics, CRC Press, Boca Raton, FL, 2011.

Webliography:

1. https://nptel.ac.in/courses/106/106/106106182/
2. https://nptel.ac.in/courses/106/106/106106145/

Semester	Course Code	Title of the Course	Category	Hours/Week	L	T	P	C
IV		**DISCRETE MATHEMATICS**	Core	3	2	1	-	3

Course Objectives:

1. This course makes the learners acquire intense knowledge of mathematical logic, set theory, relations and functions.
2. It applys rules of inference, tests for validity, and methods of proof including direct and indirect proof forms, proof by contradiction, proof by cases, and mathematical induction and write proofs using symbolic logic.
3. It simplifies and evaluates basic logic statements including compound statements, implications, inverses, converses, and contra positives using truth tables and the properties of logic.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	remember the fundamental ideas and notation of discrete mathematics with examples.	**K1**
CO2	understand and apply knowledge to analyze and solve problems using models of Discrete Mathematics	**K2**
CO3	show a binary relation on a set is an equivalence relation, or give a counterexample to show that it is not.	**K5**
CO4	understand and use the terms cardinality, finite, countably infinite, and uncountably infinite, and determine which of these characteristics is associated with a given set.	**K2, K5**
CO5	describe the connection between bijective functions, inverses and find the inverse of an invertible function.	**K1, K5**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Mathematical logic: Logical statement or proposition- type of propositions- the propositional calculus - the negation of a proposition- disjunction- conjunction- tautologies and contradictions- logical equivalence - the algebra of propositions- conditional propositions - converse inverse and contrapositive propositions - the negation of a conditional proposition - biconditional propositions - arguments. (10 hrs)

Unit II : Set theory: Set- set designation- null sets and unit sets- special sets of numbers- universal set- subsets, proper subsets and equal sets- set operations- union operations- properties of union operation- intersection- properties of intersection operation. (10 hrs)

Unit III : Distributive properties - complementation- relative complement - properties of complement - properties of difference - symmetric difference- power set- Cartesian products. (9 hrs)

Unit IV: Relation and functions: Relation- equivalence relation- partition- partial order relation. (8 hrs)

Unit V : Function - inverse mapping- composition mappings - binary operations- countable and uncountable sets. (8 hrs)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	1	3	3	2.62
CO2	3	3	3	3	2	1	3	3	2.62
CO3	3	3	3	3	2	2	3	3	2.75
CO4	3	3	3	3	2	1	3	3	2.62
CO5	3	3	3	3	3	1	3	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	2	2	2	3	2.62
CO2	3	3	3	3	3	2	1	3	2.62
CO3	3	3	3	3	3	2	1	3	2.62
CO4	3	3	3	3	3	3	1	3	2.75
CO5	3	3	3	3	3	2	1	3	2.62
Mean Overall Score									2.70 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book: Content and treatment as in

B.S. Vatssa, Discrete Mathematics - 3rdEdition, Wishwa Prakashan, 2009.

Unit I to V: Chapters 1, 2 (except 2.20) and 3.

Reference Books:

1. M.K. Venkataraman, N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing Company, Chennai, 2017.
2. J. P. Tremblay and R. Manohar, Discrete mathematical structures with applications to computer science, Tata McGraw-Hill Education, 2001.
3. R. P. Grimaldi, Discrete and Combinatorial Mathematics – An applied introduction, Pearson Addison Wesley, 5th Edition, 2004.

Webliography:

1. https://nptel.ac.in/courses/111/106/111106086/
2. https://nptel.ac.in/courses/111/104/111104026/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
V		**ABSTRACT ALGEBRA**	Core	4	3	1	-	4

Course Objectives:

1. This course deals basic concepts of groups starting from the special group's viz., Dihedral groups, General linear group, Quaternion group, and Symmetric groups.
2. It mainly deals the fundamental concepts of groups through the generalized tool of group actions.
3. This course starts with basic concepts of rings and discuss about special rings viz., matrix rings, ring of Quaternion's, group ring etc. It shall discuss and analyze the properties and interlinks between the concepts of Euclidean ring, Principal Ideal Domain, Unique Factorization Domain and Integral Domain.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the significance of the notions of cosets, normal subgroups, and factor groups.	K2, K3 & K4
CO2	Demonstrate ability to think group actions critically by Cayley's theorem.	K2
CO3	Find all conjugates of k-cycle in S_n	K3
CO4	Determine the number of zero-divisor of a finite ring	K3
CO5	Infer the irreducible element and prime element.	K4 & K6
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Semigroups and groups - homomorphisms – subgroups and cosets.   (12 hours)

Unit II: Cyclic groups - Normal subgroups - quotient groups – isomorphism theorems – automorphisms.   (12 hours)

Unit III: Permutation groups: Cyclic decomposition – alternating group A_n.   (12 hours)

Unit IV: Rings: Types of rings – Subrings and characteristic of a ring – additional examples of rings.   (12 hours)
Unit V: Ideals – homomorphisms – sum and direct sum of ideals – maximal and prime ideals.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	2	3	3	2.75
CO2	3	3	3	3	2	2	3	3	2.75
CO3	3	3	3	3	2	2	3	3	2.75
CO4	3	3	3	3	2	2	3	3	2.75
CO5	3	3	3	3	2	2	3	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									2.84 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, Second Edition, Cambridge University Press

        Unit I - Chapter 4 (Sections 1- 3)

        Unit II - Chapter 4 (Section 4) and Chapter 5 (Sections 1 - 3)

        Unit III - Chapter 7 (Sections 1 & 2),

        Unit IV- Chapter 9 (Sections 3 to 5),

        Unit V - Chapter 10 (Sections 1 to 4).

Reference Books:

1. Joseph A. Gallian, Contemporary Abstract Algebra (Seventh Edition), Brooks/Cole-Cengage Learning, USA, 2010.
2. I. N. Herstein, Abstract Algebra (Third Edition), Prentice-Hall, USA, 1990.
3. J. B. Fraleigh, A First Course in Abstract Algebra, 7th edition, Pearson Education India, New Delhi, 2008.

Webliography:

1. https://nptel.ac.in/courses/111/106/111106113/
2. https://nptel.ac.in/courses/111/106/111106137/
3. https://nptel.ac.in/courses/111/105/111105112/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
V		**METRIC SPACES**	Core	4	3	1	-	4

Course Objectives:

1. This course was studied long time for its essential for all advanced course in mathematics.
2. This course facilitates the student an entry into the portals of higher learning in mathematics.
3. It covers all the fundamentals of metric topology.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	quote and understand the definition of a limit of a sequence or a function in its various forms	K1, K6
CO2	Illustrate the concept of complete metric spaces and deduce results	K2, K5
CO3	demonstrate the equivalent characterizations of continuity and homeomorphism	K1
CO4	interpret on the properties of continuity and connectedness	K2, K4
CO5	relate the concept of compact spaces and develop the equivalent characterizations	K3
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I   : Metric spaces: Definitions and examples- Bounded sets in a metric space- open ball in a metric space- open sets- subspaces.   (12 hrs)

Unit II   Interior of a set - Closed sets - closure, limit point, dense sets - complete metric space: Introduction - Completeness - Baire's category theorem.   (12 hrs)

Unit III : Continuity: Introduction - Continuity - homeomorphism.   (12 hrs)

Unit IV: Connectedness: Introduction- definition and examples - connected subsets of R- connectedness and continuity.   (12 hrs)

Unit V : Compactness: Introduction - compact space- compact subsets of R – continuity and compactness - equivalent characterization for compactness.   (12 hrs)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									3.00 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and T. Isaac, Modern Analysis, New gamma publishing house, 2010.

Unit I to V: Chapters 2, 3, 4 (except section 4.4) ,5 and 6.

Reference   Books:

1. T. M. Apostol, Calculus (Vol. I), John Wiley and Sons (Asia) P. Ltd., 2002.
2. R.G. Bartle and D. R Sherbert, Introduction to Real Analysis , John Wiley and Sons (Asia) P. Ltd., 2000.
3. K.A. Ross, Elementary Analysis- The Theory of Calculus Series- Undergraduate Texts in Mathematics, Springer Verlag, 2003.

Webliography:

https://nptel.ac.in/courses/111/106/111106153/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
V		**STATICS**	Core	4	3	1	-	4

Course Objectives:

1. To introduce the basic laws, principles and postulates governing static system.
2. To familiarize the basic concepts and principles of statics.
3. To analyze the mechanism of physical problems, and introduce the postulates governing static system.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Retell about the outcome of forces acting at a point	K1
CO2	Analyze resultant of parallel forces and properties of moments	K4
CO3	Formulate properties of couples	K6
CO4	Describe about equilibrium of three forces acting on a rigid body	K2
CO5	Elucidate properties of coplanar forces	K3
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Forces acting at a point   **(12 hours)**

Unit II: Parallel forces and moments   **(12 hours)**

Unit III: Couples   **(12 hours)**

Unit IV: Equilibrium of three forces acting on a rigid body **(12 hours)**

Unit V: Coplanar forces   **(12 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	2	3	2	1	2	3	2.38
CO2	3	3	2	3	2	1	2	3	2.38
CO3	3	3	2	3	2	1	2	3	2.38
CO4	2	3	2	3	2	1	2	3	2.25
CO5	2	3	2	3	2	1	2	3	2.25

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	3	3	3	2	2	2.63
CO2	3	2	3	3	3	3	2	2	2.63
CO3	3	2	3	3	3	3	2	2	2.63
CO4	3	2	3	3	3	3	2	2	2.63
CO5	3	2	3	3	3	3	2	2	2.63
Mean Overall Score									**2.48 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

M. K. Venkataraman, A text book of Statics, Agasthiar Publications, 2002.

Unit I to V: Chapters 2-6

Reference Books:

1. J. L. Synge & B. A. Griffith, Principles of Mechanics. McGraw-Hill, 1949.
2. A. S. Ramsey, Statics. Cambridge University Press, 2009),.
3. R. S. Varma, A Text Book of Statics. Pothishala Pvt. Ltd. 1962.

Webliography:

https://libguides.cit.ie>mechanics>e-resources

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
V		**COMPLEX ANALYSIS**	Core	4	3	1	-	4

Course Objectives:

1. To provide fair foundation on the geometry of complex numbers and Analytic functions.
2. To introduce the concept of Contour integrals of complex functions with its properties.
3. To solve some Contour integrations using standard theorems on complex function theory.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Determine the geometry of complex numbers in systematic approach	K4
CO2	Develop Cauchy- Riemann equation to check the analyticity of complex functions	K6
CO3	Understand the geometry of cross ratio to construct bilinear transformations	K2
CO4	Explain standard theorems on Contour integration	K5
CO5	Apply residues theorem to compute real definite integrals	K3
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: nth roots of a complex number - circles and straight lines - regions in the complex plane - Riemann's stereographic projection.

Unit II: Differentiability - Cauchy Riemann equations - Analytic functions - Harmonic functions - Power series.

Unit III: Bilinear transformations - cross ratio - fixed points of Bilinear transformations - Mapping properties.

Unit IV: Complex Integration - Definite integral - Cauchy's theorem - Cauchy's integral formula - higher derivative

Unit V: Residues, Cauchy's residue theorem - evaluation of definite integrals - Type I and Type II integrals.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	-	-	3	3	3	3	3	3.00
CO2	3	-	-	3	3	3	3	3	3.00
CO3	3	-	-	3	3	3	3	3	3.00
CO4	3	-	-	3	3	3	3	3	3.00
CO5	3	-	-	3	3	3	3	3	3.00

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3.00
CO2	3	3	3	3	3	3	3	3	3.00
CO3	3	3	3	3	3	3	3	3	3.00
CO4	3	3	3	3	3	3	3	3	3.00
CO5	3	3	3	3	3	3	3	3	3.00
Mean Overall Score									3.00 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book: S. Arumugam and Isaac, Complex Analysis, Sci-Tech Publications, 2011.

Reference Books:

1. Richard A. Silverman, Introductory Complex Analysis, Dover Publications, 1984

2. Kasana, Complex Variables: Theory and Applications, PHI Publishers, 2005

3. Churchill & Brown, Complex Variables, Mc Graw Hill Publishers, 2008

Webliography:

https://nptel.ac.in/courses/111/106/111106141/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
VI		**LINEAR ALGEBRA**	Core	4	3	1	-	4

Course Objectives:

1. Problems in linear algebra arise in a wide variety of scientific and engineering applications including the design of structures, the analysis of electrical networks, and the modelling of chemical processes.
2. This course will cover the analysis and implementation of algorithms used to solve linear algebra problems in practice.
3. This course will enable students to acquire further skills in the techniques of linear algebra, as well as understanding of the principles underlying the subject.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	To determine solutions to problems and investigate the theoretical aspects of subspace and various types of linear transformations.	**K3 & K4**
CO2	Recognize the concepts of the terms span, linear independence, basis, and dimension, and apply these concepts to various vector spaces and subspaces	**K1**
CO3	Compute linear transformations, kernel and range, and inverse linear transformations, and find matrices of general linear transformations.	**K3 & K5**
CO4	Construct orthogonal and orthonormal bases: Gram-Schmidt process and use bases and orthonormal bases to solve application problems	**K3**
CO5	Relate matrices and linear transformations, compute Eigen values and Eigen vectors of linear transformations	**K4 & K5**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit 1: Vector Spaces: Definitions and Examples - Subspaces - Linear Transformation

(**12 hours**)

Unit 2: Span of a set-Linear Independence-Basis and dimension (**12 hours**)

Unit 3: Rank and Nullity - Matrix of a Linear transformation-Inner product spaces: Introduction - Definition and Examples. (**12 hours**)

Unit 4: Orthogonality- Orthogonal Complement-Theory of Matrices: Simultaneous linear Equations. **(12 hours)**

Unit 5: Characteristic equation and Cayley Hamilton Theorem **(12 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	2	3	3	2.75
CO2	3	3	3	3	2	2	3	3	2.75
CO3	3	3	3	3	2	2	3	3	2.75
CO4	3	3	3	3	2	2	3	3	2.75
CO5	3	3	3	3	2	2	3	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									2.84 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A. T. Isaac, Modern Algebra, SCITECH Publications Pvt. Ltd, Chennai.

Unit I to V: Sections**:** 5.1- 5.8, 6.0 to 6.3, 7.6 to 7.8.

Reference Books:

1. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India Ltd, 2004.
2. V. Krishnamurthy, V.P.Mainra, J.L.Arora, Introduction to Linear Algebra, East West Press Ltd, 1985.
3. S. Axler, Linear Algebra Done Right, 2nd Edition, John-Wiley, 1999

Webliography:

1. https://nptel.ac.in/courses/111/106/111106051/
2. https://nptel.ac.in/courses/111/104/111104137/
3. https://nptel.ac.in/courses/111/106/111106135/
4. https://nptel.ac.in/courses/111/108/111108098/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
VI		**GRAPH THEORY**	Core	4	3	1	-	4

Course Objectives:

1. This course is a new branch of Mathematics which got its due recognition because of its diverse applications in computer science, chemistry, sociology.
2. It is a part of Discrete Mathematics which deals with a finite set of objects.
3. Upon successful completion of this course, the students will able to use graph theory as a modelling to solve real life problems.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	understand fundamental concepts of graphs, graph operations and related results	K2
CO2	familiarized with the concepts and results on Eulerian graphs and Hamiltonian graphs	K1
CO3	Write precise and accurate mathematical definitions of basic concepts in graph theory	K3
CO4	gain knowledge in the concepts of trees and spanning trees	K1, K2
CO5	Infer the results on planar graphs and their properties	K1, K2
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Definition and Examples of Graphs - Degrees - subgraphs - (12 hrs)
isomorphism - independent sets and coverings - intersection graphs
and line graphs - matrices - operation on graphs

Unit II : Degree sequences - Graphic sequences - Walks - Trials and Paths - (12 hrs)
connectedness and components - connectivity.

Unit III : Eulerian graphs - Hamiltonian graphs - characterization of trees - (12 hrs)
centre of a tree - Matchings

Unit IV: Definition and Properties of planar graphs - characterization of (12 hrs)
planar graphs - chromatic number and chromatic index.

Unit V : Chromatic polynomials - definition and basic properties of digraphs -   (12 hrs)
paths and connectedness in digraphs - digraphs and matrices

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	3	2	3	2.75
CO2	3	3	3	3	2	3	2	3	2.75
CO3	3	3	3	3	2	3	2	3	2.75
CO4	3	3	3	3	2	3	2	3	2.75
CO5	3	3	3	3	2	3	2	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									2.90 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and S. Ramachandran, Invitation to Graph Theory, Sci-Tech Publications Pvt. Ltd., 2001.

Unit I – V: Chapters 2 to 10.

Reference   Books:

1. R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, New Delhi: Springer, 2008.
2. G. Chartrand and P. Chang, Introduction to Graph Theory, New Delhi: Tata McGraw-Hill, 2006.
3. F. Harary, Graph Theory, New Delhi: Narosa, 2001.

Webliography: https://nptel.ac.in/courses/111/106/111106102/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
VI		**DYNAMICS**	Core	4	3	1	-	4

Course Objectives:

1. To introduce the basic laws, principles and postulates governing dynamic system.
2. To cover topics like projectiles, collision of elastic bodies oblique impact of two smooth spheres, simple harmonic motion.
3. To teach the basic concepts and principles of dynamics, analyze the mechanism of physical problems, and introduce the postulates governing dynamic system.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Retell about projectiles	K1
CO2	Compute velocity of a particle	K3
CO3	Analyze resultant of collision of elastic bodies	K4
CO4	Describe about oblique impact of two smooth spheres	K2
CO5	Elucidate properties of simple harmonic motion	K3
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Projectiles   (12 hours)

Unit II: Velocity of the projectile   (12 hours)

Unit III: Collision of elastic bodies   (12 hours)

Unit IV: Oblique impact of two smooth spheres   (12 hours)

Unit V: Simple Harmonic motion   (12 hours)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	2	3	2	1	2	3	2.38
CO2	3	3	2	3	2	1	2	3	2.38
CO3	3	3	2	3	2	1	2	3	2.38
CO4	2	3	2	3	2	1	2	3	2.25
CO5	2	3	2	3	2	1	2	3	2.25

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	3	3	3	2	2	2.63
CO2	3	2	3	3	3	3	2	2	2.63
CO3	3	2	3	3	3	3	2	2	2.63
CO4	3	2	3	3	3	3	2	2	2.63
CO5	3	2	3	3	3	3	2	2	2.63
Mean Overall Score									**2.48 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

M. K. Venkataraman, A text book of Dynamics, Agasthiar publications, 1990.

Unit I to V: Chapters 6 (except 6.18), 8, and 10.

Reference Books:

1. P. L. Srivatava, Elementary Dynamics. Ram Narin Lal, Beni Prasad Publishers, Allahabad, 1964.
2. J. L. Synge & B. A. Griffith, Principles of Mechanics. McGraw-Hill, 1949.
3. A. S. Ramsey, Dynamics. Cambridge University Press, 2009.

Webliography:

https://libguides.cit.ie>mechanics>e-resources

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		ELEMENTARY NUMBER THEORY	**Elective**	**3**	**2**	**1**	**-**	**3**

Course Objectives:

1. This course was studied for its long and rich history.
2. It is well known for its wealth of easily accessible and fascinating questions, and its intellectual appeal.
3. In recent years it has been studied for the reason that it has become essential for Cryptology.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	define, interpret and apply the concepts and principles of number theory to perform numerical and symbolic computations	**K1, K6**
CO2	apply different types of proof writing techniques in number theory to related situations	**K2, K5**
CO3	develop an in-depth understanding of number theoretic functions	**K1**
CO4	communicate the number theory concepts, techniques and principles effectively in both written and oral form	**K2, K4**
CO5	understand the concept of congruence and apply it to various results	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Divisibility Theory in the Integers: Early number theory-the division algorithm-the greatest common divisor-the Euclidean algorithm **(9 hrs)**

Unit II : The Diophantine equation - Primes and their distribution: The fundamental theorem of Arithematics-the Sieve of Eraosthenes - the Goldbach conjecture. **(9 hrs)**

Unit III : The theory of congruences: basis properties of congruences - binary and decimal representations of integers - linear congruences and the Chinese remainder theorem. **(9 hrs)**

Unit IV: Fermat's theorem: Fermat's Little theorem and Pesudoprimes - Wilson theorem - The Fermat-Kraitchik factorization method. **(9 hrs)**

Unit V : Number theoretic functions: the sum and number of divisors - the **(9 hrs)** Mobius inversion function - the greatest integer function.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	3	1	3	3	2.75
CO2	3	3	3	3	3	1	3	3	2.75
CO3	3	3	3	3	3	1	3	3	2.75
CO4	3	3	3	3	3	1	3	3	2.75
CO5	3	3	3	3	3	1	3	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									**2.90 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

David M. Burton, Elementary number theory, Seventh Editions, Tata McGraw-Hill, New Delhi (2012).

Unit I to Unit V: Sections: 2.1 to 2.5, 3.1 to 3.3, 4.2 to 4.4, 5.2 to 5.4, 6.1 to 6.3

Reference Books:

1. K. Ireland and M. Rosen, A Classical Introduction to Modern Number Theory, 2nd ed., New York: Springer-Verlag, 2010.
2. G. A. Jones And J. Mary Jones, Elementary Number Theory, Springer (India) Pvt. Ltd., 1999.
3. J. H. Silverman, A Friendly Introduction To Number Theory, Pearson Prentice Hall, 2006.

Webliography: https://nptel.ac.in/courses/111/101/111101137/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		STATISTICS - I	**Elective**	**3**	**3**	**-**	**-**	**3**

Course Objectives:

1. To enable the student to understand the basic concepts and terminology in statistics.
2. To administer the students the knowledge of frequency distributions and how they are used in statistical analysis.
3. To help them identify the proper measure of central tendency to use for each level of measurement.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	memorize formulas for central tendencies and measures of dispersion	**K1**
CO2	Estimate moments, skewness and kurtosis and able to fit any given curve	**K2**
CO3	Administer knowledge of correlation and regression and their properties	**K3**
CO4	Appraise knowledge of discrete probability distributions	**K5**
CO5	Appraise knowledge of continuous probability distributions	**K5**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Central tendencies - arithmetic mean - partition values - mode - geometric mean and harmonic mean - measures of dispersion   **(9 hours)**

Unit II: Moments, Skewness and Kurtosis - Curve fitting - Method of least squares -Fitting lines - Parabolic, Exponential and logarithmic curves.   **(9 hours)**

Unit III: Correlation and regression - Scatter diagram - Karl Pearson's coefficient of correlation - Properties - Lines of regression, Regression coefficient and properties - Rank correlation.   **(9 hours)**

Unit IV: Discrete Probability Distributions: Geometric, Binomial and Poisson distributions - Their moment generating function, Characteristic function, Properties and simple application.

(9 hours)

Unit V: Continuous Probability Distributions: Beta and Gamma Distributions, Normal distribution - Standard normal distribution - Their properties - Simple Problems - Importance of normal distribution.

(9 hours)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	2	3	3	2	3	3	3	2.75
CO2	3	2	3	3	2	3	3	3	2.75
CO3	3	1	3	3	2	3	3	3	2.63
CO4	2	2	3	3	2	3	3	3	2.63
CO5	2	2	3	3	2	3	3	3	2.63

PSO \ CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	3	2	3	3	2	2.63
CO2	3	1	3	3	1	3	3	2	2.38
CO3	3	2	3	3	2	3	3	2	2.63
CO4	3	1	3	3	2	3	2	2	2.38
CO5	3	2	3	3	2	3	2	2	2.50
Mean Overall Score									2.59 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A. Thangapandi Isaac, *Statistics* - New gamma publishing house, June 2007
Unit I to V: Chapters 2 (2.1 - 2.4) Chapter 3 (3.1), 4, 5, 6, 8 and 13.

Reference Books:

1. Irwin Miller &Marylees Miller, John E. Freund's Mathematical Statistics with Applications (8th edition). Pearson. Dorling Kindersley Pvt. Ltd. India, 2014.
2. Jim Pitman, Probability, Springer-Verlag, 1993.
3. Sheldon M. Ross, Introduction to Probability Models (11th edition). Elsevier 2014.

Webliography: https://seamk.libguides.com>eresources>mobileaccess

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		STATISTICS – II	**Elective**	**3**	**3**	**-**	**-**	**3**

Course Objectives:

1. To familiarize students to design and analyse survey samples for finite populations.
2. To train the students to test or analyze their sample data with the help of several tests
3. To develop the skill to administer ANOVA tables.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain tests of significance and errors in testing of hypothesis	**K2**
CO2	Explain tests of significance and errors in testing of hypothesis using t-test	**K2**
CO3	Elucidate test based on chi square distribution	**K3**
CO4	Analyze time series and its components	**K4**
CO5	Formulate analysis of variance	**K6**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Tests of Significance (Large samples): Sampling distribution - Testing of Hypothesis - Type I and Type II errors - Critical region, level of significance - Test of significance for large samples - Testing a single proportion - Difference of proportions - testing a single mean - Difference of means. **(9 hours)**

Unit II: Tests of Significance (Large samples): Tests based on t - distribution - Single mean - Difference of means - Tests based on F - distribution. **(9 hours)**

Unit III: Test based on chi square distribution - Goodness of fit - Independence of attributes. **(9 hours)**

Unit IV: Analysis of time series: Time series - Components of a time series - measurement of trends. **(9 hours)**

Unit V: Analysis of Variance - One criterion of classification - Two criteria of classification - Three criteria of classification. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	2	3	3	2	3	3	3	2.75
CO2	3	2	3	3	2	3	3	3	2.75
CO3	3	1	3	3	2	3	3	3	2.63
CO4	2	2	3	3	2	3	3	3	2.63
CO5	2	2	3	3	2	3	3	3	2.63

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	3	2	3	3	2	2.63
CO2	3	1	3	3	1	3	3	2	2.38
CO3	3	2	3	3	2	3	3	2	2.63
CO4	3	1	3	3	2	3	2	2	2.38
CO5	3	2	3	3	2	3	2	2	2.50
Mean Overall Score									**2.59 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Arumugam and A. Thangapandi Isaac, *Statistics* - New gamma publishing House, June 2007

(For Unit I - III - Chapters 14, 15 and 16, For Unit IV - Chapter 10, For Unit V - Chapter 17).

Reference Books:

1. Irwin Miller &Marylees Miller, John E. Freund's Mathematical Statistics with Applications (8th edition), Pearson, Dorling Kindersley Pvt. Ltd. India, 2014.
2. Jim Pitman, Probability, Springer-Verlag, 1993.
3. Sheldon M. Ross Introduction to Probability Models (11th edition). Elsevier, (2014).

Webliography:

https://seamk.libguides.com>eresources>mobileaccess

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		NUMERICAL METHODS	Elective	3	3	-	-	3

Course Objectives:

1. The aim of this course is to develop the skills in solving algebraic, transcendental, differential and integral equations numerically prerequisite.
2. To perform an error analysis for various numerical methods and derive appropriate numerical methods to solve definite integrals.
3. The outcome of the course is enabling the students to get numerical (approximate) solutions wherever analytic (exact) solutions are not possible.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Solve algebraic and transcendental equations using appropriate numerical methods and approximate a function using appropriate numerical methods.	**K2**
CO2	Derive numerical methods for various mathematical operations and tasks such as interpolation, differentiation, integration and the solution of linear and nonlinear equations	**K3**
CO3	Analyze and evaluate the accuracy of common numerical methods.	**K4**
CO4	Evaluate and interpret results on real life problems using appropriate numerical techniques.	**K5**
CO5	Solve algebraic and transcendental equations using appropriate numerical methods and approximate a function using appropriate numerical methods.	**K2**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Errors in Numerical Calculations: Errors and their computations - A general error formula - Error in a series. Approximation Solution of Algebraic and Transcendental equations: The Bisection method - The Method of False position - Iteration method - Newton - Raphson method. **(9 hours)**

Unit II: Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton's Formulae for Interpolation - Gauss's central difference formulae - Stirling's formula - Interpolation with unevenly spaced points: Lagrange's interpolation formula - Inverse Interpolation. **(9 hours)**

Unit III: Numerical Differentiation: Derivatives using Newton's Forward Difference Formula -Derivatives using Newton's Backward Difference Formula - Derivatives using Stirling's Formula - Maxima and Minima of Tabulated Function. **(9 hours)**

Unit IV: Numerical Integration: General Quadrature Formula - Trapezoidal Rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule. **(9 hours)**

Unit V: Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Jacobi's method - Gauss - Seidel method. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	2	3	3	2.75
CO2	3	3	3	3	2	2	3	3	2.75
CO3	3	3	3	3	2	2	3	3	2.75
CO4	3	3	3	3	2	2	3	3	2.75
CO5	3	3	3	3	2	2	3	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									2.84 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, Prentice Hall of India, Pvt. Ltd., New Delhi, 2005.

Reference Books:

1. M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi.

2. D. Vaughan Griffiths, I. M. Smith, Numerical Methods for Engineers, Chapman &Hall, CRC, 2006.

3. V. N. Vedamurthy, S. N. Iyengar Numerical Methods, Vikas Publishing house PVT. Ltd 1998.

Webliography:

1. https://nptel.ac.in/courses/111/107/111107105/
2. https://nptel.ac.in/courses/127/106/127106019/
3. https://nptel.ac.in/courses/111/107/111107062/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		LINEAR PROGRAMMING	Elective	3	3	-	-	3

Course Objectives:

1. The aim of this course is to introduce students to linear optimization theory and its applications. The field of linear programming provides the appropriate methods for the efficient computation of optimal solutions of a problem which is modelled by a linear objective function and a set of linear constraints.
2. To appropriately formulate Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these LP problems.
3. To appropriately formulate Integer Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these IP problems

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Formulate a given simplified description of a suitable real-world problem as a linear programming model in general, standard and canonical forms	K6
CO2	Use the simplex method to solve small linear programming models by hand, given a basic feasible point.	K3
CO3	Distinguish simple method and dual simplex method.	K4
CO4	Formulate and solve the transportation problems using both manual methods and the Excel Solver, and interpret the solutions.	K6
CO5	Understand the theory of valid inequalities and how it applies to the solution of integer programs.	K2
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Definition - examples - Mathematical formulation - Standard form - Theorems (statements only) - Graphical solution - simplex method.　　　　　　　　**(9 hours)**
Unit II: The Big-M method - Two phase simplex method　　　　　　　　**(9 hours)**
Unit III: Duality - The dual of the dual is the primal - Duality theorems (Statements only) - Dual simplex method.　　　　　　　　**(9 hours)**

Unit IV: Transportation problem - Mathematical formulation - North west corner rule - method of matrix minima - Vogel's Approximation method - MODI optimality test - Assignment problem. **(9 hours)**

Unit V: Integer Programming: Gomory's cutting plane method - Branch and bound method.

(9 hours)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	2	2	3	3	2.75
CO2	3	3	3	3	2	2	3	3	2.75
CO3	3	3	3	3	2	2	3	3	2.75
CO4	3	3	3	3	2	2	3	3	2.75
CO5	3	3	3	3	2	2	3	3	2.75

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3
Mean Overall Score									2.84 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, 2014.

Unit I to V: Relevant Sections from Chapters 2, 3, 4, 6, 7 and 14.

Reference Books:

1. J K Sharma, Operations Research, Theory and Applications, Third Edition, Macmillan Publications India, 2007.
2. Frederick S. Hillier, Gerald J. Lieberman, Bodhibrata Nag, PreetamBasu, Introduction to Operational Research, Tama McGraw Hill Ltd., New Delhi, 2012.
3. S. D. Sharma, Operations Research - Theory, Methods and Applications, Kedar Nath Ram Nath, 2014.

Webliography:

http://www.digimat.in/nptel/courses/video/111104027/L11.html

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		COMBINATORIAL MATHEMATICS	**Elective**	**3**	**3**	**-**	**-**	**3**

Course Objectives:

1. For many years, this course has been studied for its essential in solving many enumeration problems.
2. It makes the students familiar with fundamental combinatorial structures that naturally appear in various other fields of Mathematics and Computer Science.
3. It develops skills to apply the techniques of combinations and permutations for counting the number of certain configurations.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	remember formulas for counting basic combinatorial outcomes to construct solutions to complete combinatorial enumeration problems	**K1, K6**
CO2	apply counting strategies to solve an optional assignment problem.	**K2, K5**
CO3	use specialized techniques to solve combinatorial enumeration problems: generating functions; recurrence relations.	**K1**
CO4	understand the concepts of permutations with restrictions on relative positions and the rook polynomials	**K2, K4**
CO5	enumerate configuration using the Inclusion - Exclusion principle	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : Selections and binomial coefficients - permutations - ordered selections - unordered selections. (9 hrs)

Unit II : Pairing problems - pairings within a set - pairing between sets - an optional assignment problem. **(9 hrs)**

Unit III : Recurrence - Fibonacci type relations - using generating functions. **(9 hrs)**

Unit IV: The Inclusion - Exclusion principle - the principle - Rook polynomials. **(9 hrs)**

Unit V : Block designs - square block designs **(9 hrs)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	3	3	2	2	3	2.75
CO2	3	3	3	3	3	2	2	3	2.75
CO3	3	3	3	3	3	2	2	3	2.75
CO4	3	3	3	3	3	2	2	3	2.75
CO5	3	3	3	3	3	2	2	3	2.75

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	3	3	3	3	3	2.87
CO2	3	2	3	3	3	3	3	3	2.87
CO3	3	2	3	3	3	3	3	3	2.87
CO4	3	2	3	3	3	3	3	3	2.87
CO5	3	2	3	3	3	3	3	3	2.87
Mean Overall Score									2.80 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

Ian Anderson, A first course in combinatorial mathematics. Oxford University Press, 1989.

Reference Books:

1. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics – An applied introduction, Pearson Addison Wesley, 5th Edition, 2004.
2. R. A. Brualdi, Introductory Combinatorics, 5th ed., China Machine Press, 2009.
3. E.A.Bender and S. G. Williamson, Foundations of combinatorics with applications,Dover Publ., 2007.
4. Jongsma Calvin, Discrete Mathematics: Chapter 0, Table of Contents and Preface,. Faculty Work: Comprehensive List. Paper 426, 2016

Webliography:

1. https://nptel.ac.in/courses/106/108/106108051/
2. https://nptel.ac.in/courses/111/104/111104026/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		CODING THEORY	**Elective**	**3**	**2**	**1**	**-**	**3**

Course Objectives:

1. This course is the study of methods for efficient and accurate transfer of information from one place to another.
2. To introduce the basic concepts of Coding Theory such as, Double Error-Correcting B.C.H. code, Cyclic codes, The Group of a code, Quadratic residue codes and Bose-Chaudhuri- Hocquenghem codes.
3. To familiarize with the developments of Cryptography.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Tabulate the basics of error correction and error detection	**K1**
CO2	Analyze and reproduce concepts of linear codes	**K4**
CO3	Administer properties of linear codes	**K3**
CO4	Explain perfect codes, hamming codes and Golay codes	**K2**
CO5	Assemble all the properties of Cyclic Codes	**K6**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Error detection, correction and decoding: Communication channels- Maximum likelihood decoding- Hamming distance- Nearest neighbor /minimum distance decoding- Distance of a code **(9 hours)**

Unit II: Linear codes: Vector spaces over finite fields- Linear codes- Hamming weight - Bases for linear codes - Generator matrix and parity-check matrix **(9 hours)**

Unit III: Linear codes: Equivalence of linear codes **-** Encoding with a linear code **-** Decoding of linear codes **-** Cosets **-** Nearest neighbour decoding for linear codes **-** Syndrome decoding **(9 hours)**

Unit IV: Bounds in coding theory: The main coding theory problem- Lower bounds- Sphere-covering bound- Hamming bound and perfect codes- Binary Hamming codes- Golay Code. **(9 hours)**

Unit V: Cyclic codes: Definitions- Generator Polynomials - Generator and parity-check matrices - Decoding of cyclic codes- Burst-error-correcting **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	2	3	3	2	2	1	3	3	
CO2	2	3	3	2	2	1	3	3	
CO3	2	3	3	3	2	1	3	3	
CO4	3	3	3	3	2	1	3	3	
CO5	3	3	3	3	2	1	3	3	

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	2	3	3	3	3	3	2	3	
CO2	2	3	3	3	3	2	2	3	
CO3	3	2	3	2	3	2	2	3	
CO4	3	2	3	2	3	3	2	3	
CO5	3	2	3	2	3	3	2	3	
Mean Overall Score									2.90 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

San Ling, Chaoping Xing, Coding Theory: A first Course, Cambridge University Press, UK, 2004.

Reference Books:

1. Vera Pless, Introduction to the Theory of Error-Correcting Codes, John Wiley & Sons, New York, 1982.
2. I.F. Blake and R.C. Mullin, Introduction to Algebraic and Combinatorial Coding
3. Theory, Academic Press, INC, New York, 1977.
4. F.J. MacWilliams and N.J.A. Sloane, The Theory of Error-Correcting Codes, Vols. I and II, North-Holland, Amsterdam, 1977

Webliography:

1. http://agnee.tezu.ernet.in>koha>opac-detail

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		OPERATIONS RESEARCH	**Elective**	**3**	**3**	**-**	**-**	**3**

Course Objectives:

1. To develop fair knowledge on the basics of Inventory control and Queuing theory.
2. To setup foundation on Network Analysis.
3. To give systematic approach to handle non-linear Problems analytically.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Explain the fundamental concepts of Inventory Theory	K5
CO2	Classify various models involving Queuing Theory	K4
CO3	Analyze Network problems both in geometrically and analytically	K4
CO4	Explain the Mathematical foundation to encounter the Nonlinear problems	K5
CO5	Apply standard theorems to handle Nonlinear problems	K3
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I   Inventory - deterministic models - uniform rate of demand, infinite state of production and no shortage - Uniform rate of demand, finite rate of replenishment and no shortage - Uniform rate of demand, instantaneous production with shortages.

Unit II   Queuing Theory - General concepts and definitions - classification of Queues - Poisson process - properties of Poisson process models:
  i. $(M/M/1):(\infty/FCFS)$
  ii. $(M/M/1):(N/FCFS)$
  iii. $(M/M/S):(\infty/FCFS)$

Unit III   Network Analysis - Drawing Network diagram - critical path method - labelling method -concept of slack and floats on network - PERT - Difference in PERT and CPM.

Unit IV   Non-linear Programming: General Non-linear Programming Problem - Problem of constrained maxima and minima - graphical solution - saddle point problems - saddle points and N. L.P.P.

Unit V   Non - linear Programming Techniques: Kuhn - Tucker conditions - Non-negative constraints - Quadratic Programming - Wolfe's modified simplex method - Beale's method - Separable convex programming.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	2	3	3	3	3	3	3	2.87
CO2	3	2	3	3	3	3	3	3	2.87
CO3	3	2	3	3	3	3	3	3	2.87
CO4	3	2	3	3	3	3	3	3	2.87
CO5	3	2	3	3	3	3	3	3	2.87

PSO CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	-	-	3	3	3	3.00
CO2	3	3	3	-	-	3	3	3	3.00
CO3	3	3	3	3	-	3	3	3	3.00
CO4	3	3	3	2	2	3	3	3	2.75
CO5	3	3	3	3	2	3	3	3	2.87
Mean Overall Score									2.92 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, (2009) Sultan Chand and Son Publications

Unit I to V: (Relevant Sections from Chapters 12, 13, 16, 17 and 19).

Reference Books:

1. Hamdy A. Taha, Operations Research, (sixth edition) Prentice–Hall of India private Limited, New Delhi, 1997.

2. S. Kalavathy, Operation Research (4th Ed), Vikas Publications, 2015

3. J.K. Sharma, Operation Research :Theory& Applications, Lakshmi Publications, 2012

Webliography:

https://nptel.ac.in/courses/112/106/112106134/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		MATHEMATICAL PROGRAMMING USING JAVA	**Elective**	**3**	**2**	**-**	**1**	**3**

Course Objectives:

1. To understand the basic concepts and fundamentals of platform independent object oriented language.
2. To demonstrate skills in writing programs using exception handling techniques and multithreading.
3. To understand streams and efficient user interface design techniques.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Write Java application programs using OOP principles and proper program structuring.	**K1**
CO2	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages.	**K6**
CO3	Apply the concepts of Multithreading and Exception handling to develop efficient and error free codes	**K3**
CO4	Design event driven GUI and web related applications which mimic the real word scenarios.	**K6**
CO5	Understand the basics of java console and GUI based programming.	**K2**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Introduction to JAVA - History - Overview - JAVA application programs - JAVA Applets - commands line arguments - Data types - variables - comments. **(9 hours)**

Unit II: Objects and Classes - Defining a class - constructors - multiple constructors - wrapper classes - conversion of data types - command live and keyboard input - Attributes and methods - Attributes - overriding - object composition with a simple example. (**9 hours**)

Unit III: If structure - nested if structure - break and labelled break - switch structures while loop - do loop - for loop - natural sum and partial sum of series using loops - Divergent series verification using loops - nested loop. **(9 hours)**

Unit IV: HTML entity encoding in JAVA - JAVA string encoding- attributes - encoding schemes that are supported by the JAVA platform - character encoding - objects, Images and applets in HTML documents.   **9 hours)**

Unit V: JAVA script - Grammar - objects - functions - inheritance - Arrays.   **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	2	3	3	3	2	2	3	3	2.63
CO2	2	3	3	3	2	2	3	3	2.63
CO3	2	3	3	3	2	2	3	3	2.63
CO4	2	3	3	3	2	2	3	3	2.63
CO5	2	3	3	3	2	2	3	3	2.63

PSO \ CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	3	1	3	2.63
CO2	3	3	3	3	3	3	1	3	2.63
CO3	3	3	3	3	3	3	1	3	2.63
CO4	3	3	3	3	3	3	1	3	2.63
CO5	3	3	3	3	3	3	1	3	2.63
Mean Overall Score									2.63 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Books:

1. C. Xavier, Programming with JAVA 2, Sci-Tech Publication, India.

2. Herbert Schildt, JAVA 2: The Complete Reference, Fifth Edition, 2002.

Reference Books:

1. E. Balagurusamy, Programming with JAVA: A Primer, Fifth Edition, McGraw Hill Education Private Limited, New Delhi, 2014
2. David J. Eck, Introduction to Programming Using Java, e Creative Commons Attribution-Share Alike, USA, 2007.
3. E Balagurusamy, Programming with JAVA, 6thEdition, Tata McGraw Hill, New Delhi, 2019.

Webliography:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://nptel.ac.in/courses/106/105/106105225/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		INTEGRAL TRANSFORMS & APPLICATIONS	**Elective**	**3**	**3**	**-**	**-**	**3**

Course Objectives:

1. This course introduces the basic concepts of Integral transforms and Fourier series.

2. For many years, it has been studied for its essential in applied mathematics, and especially in the field of physics and electronics.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	acquire problem solving skills on Fourier Series, Fourier Transforms and Laplace Transforms	**K1, K6**
CO2	gain familiarity in fundamental theories on Fourier Series, Fourier Transforms and Laplace Transforms	**K2, K5**
CO3	evaluate some standard integrals by using Fourier Integrals	**K1**
CO4	understand different types of Fourier integrals.	**K2, K4**
CO5	apply Laplace transforms in solving ordinary differential equations.	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I : The Laplace transforms: Definition - sufficient conditions for the existence of the Laplace transform - Laplace transform of periodic functions - some general theorems **(9 hrs)**

Unit II : The inverse transforms. **(9 hrs)**

Unit III : Applications to differential equations - solving simultaneous equations and differential equations with variable coefficients. **(9 hrs)**

Unit IV: Fourier series - even and odd functions - half - range Fourier series. **(9 hrs)**

Unit V : Fourier Transform – Complex form of Fourier integral formula - Fourier integral theorem – properties of Fourier transform – Fourier cosine and Fourier sine transforms and their properties. **(9 hrs)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	3	3	2	2	1	3	3	2.5
CO2	3	3	3	2	2	1	3	3	2.5
CO3	3	3	3	2	2	1	3	3	2.5
CO4	3	3	3	2	2	1	3	3	2.5
CO5	3	3	3	2	2	1	3	3	2.5

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	1	-	1	1	3	2.14
CO2	3	3	3	1	-	1	1	3	2.14
CO3	3	3	3	1	-	1	1	3	2.14
CO4	3	3	3	1	-	1	1	3	2.14
CO5	3	3	3	1	-	1	1	3	2.14
Mean Overall Score									2.30 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

S. Narayanan and T. K. Manicavachagom Pillay, Calculus - Volume III, S. Viswanathan (Printers and Publishers) Pvt. Ltd.2008.

Unit I to Unit V: Chapters 5 and 6 (Sections 1 to 4 & 9 to 12)

Reference   Books:

1. B. Davis, Integral transforms and their Applications, 2nd ed., Springer Science and Business Media, 2013.
2. M.D. Raisinghania, Advanced Differential Equations, S Chand and Company Ltd., 2018.
3. E Kreyszig, Advanced Engineering Mathematics, Eighth Edition, New Delhi, India: Wiley India Pvt. Ltd., 2010.

Webliography: https://nptel.ac.in/courses/111/102/111102129/

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		SPECIAL FUNCTIONS	Elective	3	2	1	-	3

Course Objectives:
1. To invent knowledge of some special functions.
2. To familiarize with the properties of these functions.
3. To discover applications of these functions.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Visualize exponential, logarithmic and trigonometric functions	**K1**
CO2	Appraise knowledge of beta and gamma functions	**K5**
CO3	Discover applications of gamma functions to multiple integrals	**K2**
CO4	Adapt knowledge of Legendre's equation and their orthogonal properties	**K6**
CO5	Examine Bessel's equation and their solution	**K3**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: The exponential function - the logarithmic function - definition of x^a – the trigonometric functions. **(9 hours)**

Unit II: Beta and gamma functions. **(9 hours)**

Unit III: Applications of Gamma functions to multiple integrals. **(9 hours)**

Unit IV: Legendre 's equation - solution - Legendre's function of the first and second kinds - Orthogonal properties of Legendre's Polynomial. **(9 hours)**

Unit V: Bessel's equations and Bessel's functions - Definition and solution - Bessel's function of the first kind of order n - generating function- some trigonometric expansions involving Bessel's functions. **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	2	3	3	2	3	3	3	2.75
CO2	3	2	3	3	2	3	3	3	2.75
CO3	3	1	3	3	2	3	3	3	2.63
CO4	2	2	3	3	2	3	3	3	2.63
CO5	2	2	3	3	2	3	3	3	2.63

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	3	2	3	3	2	2.63
CO2	3	1	3	3	1	3	3	2	2.38
CO3	3	2	3	3	2	3	3	2	2.63
CO4	3	1	3	3	2	3	2	2	2.38
CO5	3	2	3	3	2	3	2	2	2.50
Mean Overall Score									2.59 High

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

1. R.R.Goldberg, Methods of Real analysis, Oxford and IBH Publishing, 1963
   (For Unit I - Chapter 8 -Sections 8.2 to 8.4)
2. S. Narayanan and T. K. Manicavachagom Pillay, Calculus - Volume II - S. Viswanathan (Printers and Publishers) Pvt. Ltd. 2008.
   (For Unit II - Chapter 7 - Sections 1 to 5: For Unit III Chapter 7 - Section 6).
3. U.P. Singh, R.Y. Denis , S. K.D. Dubey and K.N.Singh, Differential Equations and Integral transforms, (2005) Dominant Publishers and Distributors.
   (For Unit IV - 4.1 and for Unit V - 4.2).

Reference Books:

1. George Andrews, Special functions, 1999
2. IU.A Brychkov, Handbook of special functions, 2008
3. Larry Andrews, Special functions of Mathematics for Engineers,1992

Webliography: https://web.mst.edu>Imhall>SPFNS>spfns

Semester	Course Code	Title of the Course	Category	Hours/Week	L	T	P	C
		MATHEMATICAL LOGIC	**Elective**	**3**	**2**	**1**	**-**	**3**

Course Objectives:

1. To illustrate various proof techniques.

2. To administer knowledge of conjunctive and disjunctive normal forms.

3. To familiarize students about axiom of choice, ordinals and cardinals.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Adapt various proof techniques	**K6**
CO2	Tabulate truth tables, conditional and biconditional statements	**K1**
CO3	Represent tautology, disjunctive and conjunctive normal forms	**K2**
CO4	Employ axiom of choice and Zorn's lemma	**K3**
CO5	Categorize ordinals and cardinals	**K4**
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Mathematical Induction - Techniques of proof.   **(9 hours)**

Unit II: Mathematical logic - Statements and notations - connectives - statement formulas and truth tables - conditional and biconditional statements - well formed formulas. **(9 hours)**

Unit III: Tautology - equivalence of formulas - duality law - principal disjunctive and conjunctive normal forms.   **(9 hours)**

Unit IV: Axiom of choice - Zorn's lemma - well - ordering - Zermelo's theorem - Schroder-Bernstein theorem.   **(9 hours)**

Unit V: Ordinals and Cardinals.   **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	2	3	3	2	2	1	3	3	2.38
CO2	1	3	3	2	2	1	3	3	2.25
CO3	2	3	3	2	2	1	3	3	2.38
CO4	1	3	3	1	2	1	3	3	2.13
CO5	2	3	3	1	2	1	3	3	2.25

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	3	3	3	3	2	2	3	2.75
CO2	3	3	3	3	3	2	2	3	2.75
CO3	3	3	3	3	3	2	1	3	2.63
CO4	3	3	3	3	3	1	1	3	2.50
CO5	3	3	3	3	3	1	2	3	2.63
Mean Overall Score									**2.47 High**

Level of correlation: 3-High, **2**-Medium, **1**-Low

Text Book:

1. M.K. Venkataraman, N. Sridharan and N. Chandrasekaran, Discrete Mathematics, The National Publishing Company (Edition - June 2006) (For units I, II and III).
2. Paul. R. Halmos, Naïve set theory, Springer International Edition (1960)
   (For Unit IV - Chapters 15 to 17 and 22; For Unit V - Chapters 19 to 21, 24 and 25).

Reference Books:

1. Michal Walicki, Introduction to Mathematical logic, 2011
2. Peter G.Hinman, Fundamentals of Mathematical logic, 2005
3. Robert Roth Stoll, Set theory and logic, 1963

Webliography:

https://mathoverflow.net>questions>reading-materials

Semester	Course Code	Title of the Course	Category	Hours/ Week	L	T	P	C
		ASTRONOMY	Elective	3	2	1	-	3

Course Objectives:

1. To familiarize students with knowledge of the material universe beyond the earth's atmosphere and the nature and constitution of heavenly bodies.
2. To promote knowledge on the topics spherical trigonometry, the zones of earth, refraction, laws of refraction, geocentric parallax and Kepler's laws.
3. To appraise that students gather knowledge about celestial bodies and their movements in the galaxy.

Course Outcomes (COs):

On completion of this course the students will be able to

Course Outcome No.	Course Outcome	Knowledge Level Upto
CO1	Solve problems in spherical Trigonometry	K3
CO2	Evaluate terrestrial latitudes and longitudes	K5
CO3	Rewrite laws and effects of refraction	K6
CO4	Estimate effects of geocentric parallax	K4
CO5	Interpret Kepler's laws and deduce its applications	K2
K1=Remember, K2=Understand, K3=Apply, K4=Analyze, K5=Evaluate, K6= Create		

Course Outline:

Unit I: Spherical Trigonometry - Celestial sphere- Diurnal motion.   **(9 hours)**

Unit II: Earth - the zones of Earth - Terrestrial latitudes and longitudes - radius of earth - rotation of earth - Dip of horizon - Twilight.   **(9 hours)**

Unit III: Refraction laws of refraction - effects of refraction - cassini's formula horizontal refraction.   **(9 hours)**

Unit IV: Geocetric parallax - effects - horizontal parallax of moon - angular diameter - comparison of geocentric parallax and refraction.   **(9 hours)**

Unit V: Kepler's laws - longitude of perigee - eccentricity of earth's orbit - verification of Kepler's laws in the case of Earth Newton's deductions form Kepler's laws mean anomaly - Geocentric and heliocentric latitudes and longitudes.   **(9 hours)**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	Mean Score
CO1	3	2	2	2	2	1	3	3	2.25
CO2	3	2	1	2	2	1	3	3	2.13
CO3	3	1	2	2	2	1	3	3	2.13
CO4	2	1	2	3	2	1	3	3	2.13
CO5	2	2	1	3	2	1	3	3	2.13

PSO / CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8	Mean Score
CO1	3	2	3	2	3	3	3	2	2.63
CO2	3	2	3	2	3	3	3	2	2.63
CO3	3	2	3	1	3	3	3	2	2.50
CO4	3	2	3	1	3	2	2	2	2.25
CO5	3	2	3	2	3	2	2	2	2.25
Mean Overall Score									2.30 High

Level of correlation: **3**-High, **2**-Medium, **1**-Low

Text Book:

S. Kumaravelu and Susheela Kumaravelu, Astronomy SKV. Publications, 2004

Reference Books:

1. Stephen P. Maran, Astronomy for dummies,1999
2. Andrew Fracknoi, Astronomy, 2016
3. Dinah L Mochi, Astronomy, 1978

Webliography:

https://www.sciencefocus.com>Books