M. Sc. Mathematics with Computer Applications

Syllabus

(with effect from 2025 onwards)

Program Code: 25AMAA

DEPARTMENT OF APPLIED MATHEMATICS

Bharathiar University

(A State University, Accredited with "A++" Grade by NAAC and
26th Rank among Indian Universities by MoE-NIRF)

Coimbatore 641 046, INDIA

BHARATHIAR UNIVERSITY: : COIMBATORE 641 046
DEPARTMENT OF APPLIED MATHEMATICS

MISSION

- To impart strong mathematical background, abstract understanding, analytical and computational skills, which enable to face the changing scenario and to handle any industrial/research problem.
- To develop knowledge and a passion for science towards the needs concerning the society.
- To give opportunities for emerging high quality mathematical skilled students for becoming fruitful researchers.
- To introduce international standard quality research in the thrust areas.
- To build graduates with leadership quality for devoted services to the society.
- To encourage, make and empower students to succeed in the ever-changing world.

Program Educational Objectives (PEOs)	
The M. Sc. Mathematics with Computer Applications program describes accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	To demonstrate professional development that provokes to keep on learning new avenues in emerging fields of pure and applied mathematics.
PEO2	To maintain the knowledge of mathematics and scientific computational techniques to interconnect hypothesis, theoretical design and computational model.
PEO3	To progress a work force that is furnished with the mathematical skills that are necessary in the altering industrial and socio-economic development of the country.
PEO4	To develop students self-confidence in guiding research independently or within a group and have the ability to pursue multidisciplinary research in universities in India and abroad.
PEO5	To enhance the awareness of the graduates on public concern and to instill moral and ethical behaviors to shape them as well human beings.

Program Specific Outcomes (PSOs)	
After the successful completion of M. Sc. Mathematics with Computer Applications program, the students are expected to	
PSO1	Apply knowledge of advanced models and methods of mathematics to outfit to the needs of society and to solve real world problems in suitable structures.
PSO2	Develop specific skills in independently investigating, modeling and solving problems at a high level of perception.
PSO3	Gain a research oriented learning that develops analytical / logical / innovative and integrative problem solving approaches.
PSO4	Identify and recognize the connections between theory and applications efficiently and adopt to use professional information and technological tools to support communication and develop the study of mathematics.

Program Outcomes (POs)	
On successful completion of the M. Sc. Mathematics with Computer Applications program, the students will be able to	
PO1	Communicate effectively with the mathematical concepts, models, explanation, interpretation and solutions in various ways.
PO2	Do self-learning and update with advanced technological challenges of computer science and mathematics at the national level and to remain globally competitive.
PO3	Demonstrate competence in using mathematical and computational skills to model, formulate and solve real life applications.
PO4	Carry out development work as well as take up challenges in the emerging areas of industry.
PO5	Identify the preparation and ability to engage in independent learning in the biggest circumstance of technology for the betterment of individuals, organization and society.
PO6	Use research-based knowledge and research methods including development of algorithms, analysis and interpretation of data, and creation of the information to provide effective inferences.
PO7	Validate the ability to conduct research independently and pursue higher studies in mathematics and computing.

BHARATHIAR UNIVERSITY : : COIMBATORE 641 046

M. Sc. Mathematics with Computer Applications Curriculum (University Department)

(For the students admitted during the academic year 2025 – 26 onwards)

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
25AMAA13A	Abstract Algebra	4	5	-	25	75	100
25AMAA13B	Real Analysis	4	5	-	25	75	100
25AMAA13C	Ordinary Differential Equations	4	5	-	25	75	100
25AMAA13D	Programming in C++	2	2	-	12	38	50
25AMAA13P	Practical I : Programming in C++	2	-	4	12	38	50
25AMAA1EA /25AMAA1EB	Numerical Analysis/ Mathematical Statistics	4	5	-	25	75	100
251GS--	Supportive – I (Offered from other Departments)	2	2	-	12	38	50
25AMAA1JA	JOCC I - Latex	2*	-	-	12	38	50
Total		22	24	4	136	414	550
SECOND SEMESTER							
25AMAA23A	Complex Analysis	4	5	-	25	75	100
25AMAA23B	Partial Differential Equations	4	5	-	25	75	100
25AMAA23C	Mechanics	4	5	-	25	75	100
25AMAA23D	Java Programming	2	2	-	12	38	50
25AMAA23P	Practical II : Java Programming	2	-	4	12	38	50
25AMAA2EC/ 25AMAA2ED	Linear Algebra / Graph Theory	4	5	-	25	75	100
251GS--	Supportive – II (Offered from other Departments)	2	2	-	12	38	50
25AMAA2VA	VAC I - Introduction to Machine Learning	2*	-	-	12	38	50
Total		22	24	4	136	414	550
THIRD SEMESTER							
25AMAA33A	Topology	4	5	-	25	75	100
25AMAA33B	Fluid Dynamics	4	5	-	25	75	100
25AMAA33C	Mathematical Methods	4	5	-	25	75	100
25AMAA33D	Matlab	2	2	-	12	38	50

25AMAA33P	Practical III : Matlab	2	-	4	12	38	50
25AMAA3EE/ 25AMAA3EF	Fuzzy Sets and their Applications/ Discrete Mathematics	4	5	-	25	75	100
251GS--	Supportive – III (Offered from other Departments)	2	2	-	12	38	50
	Self-Learning Course - Health & Wellness	1	-	2	100	-	100
25AMAA3JA	JOCC II - Mathematical Skill Development	2*	-	-	12	38	50
Total		23	24	6	236	414	650
FOURTH SEMESTER							
25AMAA43A	Functional Analysis	4	5	-	25	75	100
25AMAA43B	Optimization Techniques	4	5	-	25	75	100
25AMAA43C	Python Programming	2	2	-	12	38	50
25AMAA43P	Practical IV : Python Programming	2	-	4	12	38	50
25AMAA4EG /25AMAA4EH	Control Theory/ Elements of Stochastic Processes	4	4	-	25	75	100
25AMAA47V	Project Work and Viva-Voce Examination	8	8	-	100	100	200
25AMAA4VA	VAC II - Introduction to Artificial Intelligence	2*	-	-	12	38	50
	Total	24	24	4	199	401	600
Grand Total		91	96	18	707	1643	2350
ONLINE COURSES							
SWAYAM – MOOC-Online Course #		2	-	-	-	-	-

As per UGC (Credit Framework for Online Learning Courses through **SWAYAM**) Regulation 2016, it is encouraged the use of SWAYAM (Study Web of Active Learning by Young and Aspiring Minds) platform. Based on the availability of relevant courses on SWAYAM, students shall choose online courses from **Coursera, NPTEL, MOOC, Udacity**, etc. as extra credit (without marks) courses.

SWAYAM-MOOC- online course shall be of duration at least 4 weeks with at least 2 credits. The course shall be mandatory and shall be completed within the third semester (i.e., before the beginning of the fourth semester). This shall not be taken for the calculation of grade point average (GPA).

On submission of the valid course certificate before the completion of the programme, it can be added to the mark sheets.

* In addition, job-oriented certificate courses and value added courses are introduced. The courses are non-scholastic courses and the credits earned will be add-on credits.

SUPPORTIVE COURSES FOR OTHER DEPARTMENT STUDENTS

Course Code	Title of the Course	Credits	Hours		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST/ THIRD SEMESTER							
GS01	Numerical Methods	2	2	-	12	38	50
SECOND SEMESTER							
G144	Operations Research	2	2	-	12	38	50

M.Sc., Core and Elective Theory Examination having the following Marks:

<u>CORE AND ELECTIVE PAPERS:</u> MAXIMUM MARKS – 100

I) Continuous Internal Assessment (CIA): 25 Marks

Tests	15 Marks
Assignment	5 Marks
Seminar	5 Marks
Total	25 Marks

i) Three tests (Test 1, Test 2 and Test 3) for continuous internal assessment for each core/elective papers offered in a semester shall be conducted in the following manner:

- Test 1 and Test 2 may be the unit-based tests.
- Test 3 may be the model test.
- 25% weightage of each of Test 1 and Test 2, and 50% weightage of Test 3.
- It is mandatory for every student to attend at least one test in every subject.

ii) The average of two or three assignments for continuous internal assessment for each core/elective papers offered in a semester shall be taken as the marks for the assignment component.

iii) At least one seminar shall be considered to arrive at the marks for seminar component.

II) End Semester Examination (ESE): 75 Marks

SECTION– A: (10x1=10 Marks)
Answer *All* the questions
Each question carries *one* mark

Q. No. 1 - Q. No. 10 – Objective questions with four multiple choices.
(There shall be two questions each with four multiple choices from each of the five units).

SECTION– B: (5x5=25 Marks)
Answer *All* the questions
Each question carries *five* marks

Q. No. 11 - Q. No. 15 – Questions for short answers with internal choices.
(There shall be two questions each with internal choice (either /or type) from each of the five units).

SECTION– C: (5x8=40 Marks)
Answer *All* the questions
Each question carries *eight* marks

Q. No. 16 - Q. No. 20 – Questions for long answers with internal choices.
(There shall be two questions each with internal choice (either /or type) from each of the five units).

CORE PAPERS: MAXIMUM MARKS– 50

I) Continuous Internal Assessment (CIA): 12 Marks

Tests	8 Marks
Assignment	2 Marks
Seminar	2 Marks
Total	12 Marks

i) Three tests (Test 1, Test 2 and Test 3) for continuous internal assessment for each core papers offered in a semester shall be conducted in the following manner:

- Test 1 and Test 2 may be the unit-based tests.
- Test 3 may be the model test.
- 25% weightage of each of Test 1 and Test 2, and 50% weightage of Test 3.
- It is mandatory for every student to attend at least one test in every subject.

ii) The average of two or three assignments for continuous internal assessment for each core papers offered in a semester shall be taken as the marks for the assignment component.

iii) At least one seminar shall be considered to arrive at the marks for seminar component.

II) End Semester Examination (ESE): 38 Marks

SECTION – A: (5x1=5 Marks)
Answer *All* the questions
Each question carries *One* mark

Q. No. 1 - Q. No. 5 – Objective questions with four multiple choices.
(There shall be one question each with four multiple choices from each of the five units).

SECTION – B: (5x3=15 Marks)
Answer *All* the questions
Each question carries *three* marks

Q. No. 6 - Q. No. 10 – Questions with internal choices.
(There shall be two questions each with internal choice (either / or type) from each of the five units).

SECTION – C: (3x6=18 Marks)
Answer *All* the questions
Each question carries *six* marks

Q. No. 11 - Q. No. 13 – Questions for long answers with internal choices.
(There shall be three questions with internal choice (either / or type) from all the five units).

M.Sc., Practical Examination having the following Marks:

PRACTICAL: MAXIMUM MARKS– 50

I) Continuous Internal Assessment (CIA): 12 Marks

Tests	8 Marks
Observation Note	2 Marks
Lab assessment	2 Marks
Total	12 Marks

Three tests (Test 1, Test 2 and Test 3) for continuous internal assessment for each practical papers offered in a semester shall be conducted in the following manner:

- Test 1 and Test 2 may be the course content based tests.
- Test 3 may be the model test.
- 25% weightage of each of Test 1 and Test 2, and 50% weightage of Test 3.
- It is mandatory for every student to attend at least one test in every subject.

II) End Semester Examination (ESE): 38 Marks

Practical	30 Marks
Record	8 Marks
Total	38 Marks

<u>SUPPORTIVE PAPERS</u>: MAXIMUM MARKS– 50

I) Continuous Internal Assessment (CIA): 12 Marks

Tests	8 Marks
Assignment	2 Marks
Seminar	2 Marks
Total	12 Marks

i) Three tests (Test 1, Test 2 and Test 3) for continuous internal assessment for each supportive paper offered in a semester shall be conducted in the following manner:

- Test 1 and Test 2 may be the unit-based tests.
- Test 3 may be the model test.
- 25% weightage of each of Test 1 and Test 2, and 50% weightage of Test 3.
- It is mandatory for every student to attend at least one test in every subject.

ii) The average of two or three assignments for continuous internal assessment for each supportive paper offered in a semester shall be taken as the marks for the assignment component.

iii) At least one seminar shall be considered to arrive at the marks for seminar component.

II) End Semester Examination (ESE): 38 Marks

SECTION– A: (5x1=5 Marks)
Answer *All* the questions
Each question carries One mark

Q. No. 1 - Q. No. 5 – Objective questions with four multiple choices.
(There shall be one question each with four multiple choices from each of the five units).

SECTION– B: (5x3=15 Marks)
Answer *All* the questions
Each question carries three marks

Q. No. 6 - Q. No. 10 – Questions with internal choices.
(There shall be two questions each with internal choice (either /or type) from each of the five units).

SECTION– C: (3x6=18 Marks)

Answer *All* the questions

Each question carries six marks

Q. No. 11 - Q. No. 13 – Questions for long answers with internal choices.

(There shall be three questions with internal choice (either/or type) from all the five units).

PROJECT:

MAXIMUM MARKS – 200

Continuous Internal Assessments	100 Marks
Evaluation	60 Marks
Viva -Voce	40 Marks
Total	200 Marks

SELF-LEARNING COURSE (SLC):

MAXIMUM MARKS – 100

Report	40 Marks
Attendance	20 Marks
Activities (Observation During Practice)	40 Marks
Total	100 Marks

First Semester

Course code	25AMAA13A	ABSTRACT ALGEBRA	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		A foundation in logic and set theory.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce the basic ideas of counting principle, Sylow's subgroups, finite abelian groups, splitting field and Galois theory.
2. Apply it to the solvability of polynomial equations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand and demonstrate competence with the basic ideas of algebra including the concepts of direct products, splitting fields, Galois group and solvable group.	K1,K2
2	Demonstrate knowledge of the structures of fields, extension fields and finite fields.	K3
3	Analyze and appreciate the significance of Sylow's theorem and Galois theory.	K4
4	Construct mathematical proof for various theorems in Algebra.	K5
5	Analyze the solvability of polynomials by radicals.	K4,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Sylow's Theorem	14 hours

Counting principle – Three parts of Sylow's theorems – Double coset – The normalizer of a group.

Unit:2	Finite Abelian Groups	15 hours

External and internal direct products – Structure theorem for finite Abelian groups – Non isomorphic Abelian groups - Polynomial rings.

Unit:3	Splitting Field	15 hours

Polynomials over rational fields – The Eisenstein criterion - Extension fields – Roots of polynomials – Splitting fields.

Unit:4	Galois Theory	16 hours

Derivative of a polynomial – Simple extension – Separable extension – Fixed fields – Symmetric rational functions – Normal extension – Galois group – Fundamental theorem of Galois theory.

Unit:5	Solvability by Radicals	13 hours

Solvable group – The commutator subgroup – Solvability by radicals – Finite fields.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture Hours	**75 hours**

Text Book:

1	I.N. Herstein, Topics in Algebra, Second Edition, John Wiley and Sons, New York, 2006.

Reference Books:

1	John B. Fraleigh and N.E. Brand, A First Course in Abstract Algebra, Eighth Edition, Pearson Education, New Jersey, 2020.
2	M. Artin, Algebra, Second Edition, Prentice-Hall of India, New Delhi, 2011.
3	T.A. Hungerford, Algebra, Second Edition, Springer-Verlag, New York, 2015.
4	Joseph A. Gallian, Contemporary Abstract Algebra, Ninth Edition, Brooks/Cole Cengage Learning, Boston, 2017.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/106/111106051/
2	https://swayam.gov.in/nd1_noc20_ma31/preview
3	https://swayam.gov.in/nd1_noc20_ma25/preview
4	https://math.libretexts.org/Bookshelves/Abstract_Algebra/
5	https://swayam.gov.in/nd1_noc20_ma25/preview
6	https://swayam.gov.in/nd2_cec20_ma15/preview

Course Designed By: **Dr. P. JAYARAMAN**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	M
CO3	S	S	S	S	S	S	S
CO4	S	S	M	M	M	S	S
CO5	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

Course code	25AMAA13B	REAL ANALYSIS	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basics of real numbers, Set theory, Sequence and Series.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Have a detailed study of continuity, uniform continuity, differentiability Riemann Stieltjes integral and the calculus on $\mathbb{R}_n$.
2. Include axioms of real number systems, uniform convergence of sequences and series of functions, equicontinuity, uniform convergence and integration and differentiation, the inverse function theorem, the Stone-Weierstrass theorem and contraction map.
3. Know about convergence of sequences and Lebesgue measure and integration.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Determine the Riemann-Stieltjes integrability of a bounded function and prove a selection of theorems and concerning integration.	K1
2	Recognize the difference between pointwise and uniform convergence of a sequence of functions.	K5
3	Analyze transformations and evaluate derivatives and differentiation of integrals.	K4
4	Understand measure theory and integration from theoretical point of view and apply its tools in different fields of applications.	K2
5	Extend their knowledge of Lebesgue theory of integration by selecting and applying its tools for further research in this and other related areas.	K3, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	The Riemann- Stieltjes Integral	14 hours

Definition and existence of the integral – Properties of the integral – Integration and differentiation – Integration of vector valued functions – Rectifiable curves.

Unit:2	Sequences and Series of Functions	15 hours

Uniform convergence - Uniform convergence and continuity – Uniform convergence and integration – Uniform convergence and differentiation – Equicontinuous families of functions – The Stone-Weierstrass theorem.

Unit:3	Functions of Several Variables	14 hours

Linear transformations – The contraction principle – The inverse function theorem – The implicit function theorem – Determinants – Derivatives of higher order – Differentiation of integrals.

Unit:4	Lebesgue Measure	15 hours

Outer measure – Measurable sets and Lebesgue measure – A nonmeasurable set - Measurable functions – Littlewood's three principles.

Unit:5	**The Lebesgue Integral**	**15 hours**
The Lebesgue integral of a bounded function over a set of finite measure – The integral of a nonnegative function – The general Lebesgue integral – Convergence in measure.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture Hours	**75 hours**

Text Books:

1	W. Rudin, Principles of Mathematical Analysis, Third Edition, McGraw-Hill, New York, 2003.
2	H.L. Royden, Real Analysis, Third Edition, Macmillan Publishing Company, New Delhi, 1988.

Reference Books:

1	Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1997.
2	S. Kumaresan, Topology of Metric Spaces, Second Edition, Alpha Science International Ltd., Harrow, 2022.
3	S. Ponnusamy, Foundations of Mathematical Analysis, Springer, New York, 2012.
4	Inder K. Rana, An Introduction to Measure and Integration, Second Edition, Narosa Publishing House, New Delhi, 2015.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.classcentral.com/course/swayam-basic-real-analysis-17525
2	https://nptel.ac.in/course.html
3	https://www.adelaide.edu.au/course-outlines/104831/1/sem-2/

Course Designed By: **Dr. N. SAKTHIVEL**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	25AMAA13C	ORDINARY DIFFERENTIAL EQUATIONS	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basics of calculus including differentiation, integration, series, and methods of approximation.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce the basic theory of ordinary differential equations and apply to dynamical problems of practical interest.
2. Develop a strong background on finding solutions to linear differential equations with constant and variable coefficients and also with regular singular points.
3. Prepare students to solve problems arising from mathematical models of physical and engineering processes.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain knowledge about second order linear equations, Legendre equation and Bessel equations etc., which provides the essential motivation in applied mathematics.	K1,K2
2	Evaluate the solution of the ordinary differential equations of first and second order.	K5
3	Identify the problems associated with ODEs in nature.	K6
4	Recognize the concepts of ODEs and system of ODEs that are encountered in the real world in order to solve the problems using various approaches.	K4
5	Apply the learned techniques to solve problems in various disciplines.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Linear Equations with Constant Coefficients	15 hours

The second order homogeneous equations – Initial value problems – Linear dependence and independence – A formula for the Wronskian – The non-homogeneous equation of order two.

Unit:2	Homogeneous and Non-Homogeneous Equations of Order 'N'	14 hours

Initial value problems – A special method for solving the non-homogeneous equation – Algebra of constant coefficient operators.

Unit:3	Linear Equations with Variable Coefficients	16 hours

Initial value problems for the homogeneous equation – Solutions of the homogeneous equation – The Wronskian and linear independence – Reduction of the order of a homogeneous equation – Homogeneous equation with analytic coefficients – The Legendre equation.

Unit:4	Linear Equations with Regular Singular Points	14 hours
Euler equation – Second order equations with regular singular points – Exceptional cases – Bessel equation.		
Unit:5	**Existence and Uniqueness of Solutions to First Order Equations**	**14 hours**
Equation with variables separated – Exact equations – The method of successive approximations – The Lipchitz condition – Convergence of the successive approximations.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture Hours	**75 hours**

Text Book:

1	E.A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publications, New York, 2012.

Reference Books:

1	W.E. Boyce and R.C. Di-Prima, Elementary Differential Equations and Boundary Value Problems, Ninth Edition, John Wiley & Sons, New York, 2008.
2	G.F. Simmons, Differential Equations with Applications and Historical Notes, Third Edition, CRC Press, New York, 2017.
3	P.J. Collins, Differential and Integral Equations, Oxford University Press, New Jersey, 2006.
4	M.D. Raisinghania, Advanced Differential Equations, S. Chand & Company Ltd., New Delhi, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/107/111107111/
2	https://nptel.ac.in/courses/111/104/111104031/
3	https://nptel.ac.in/courses/111/106/111106100/

Course Designed By: **Dr. R. SAKTHIVEL**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	25AMAA13D	Programming in C++	L	T	P	C
Core/Elective/Supportive		Core	2	-	-	2
Pre-requisite		A foundation in programming concepts and problem-solving.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Provide an insight to programming languages and introduce the object-oriented programming concept.
2. Impart the characteristics, benefits and key features of object-oriented programming in C++.
3. Make the students to get across the notions of objects, classes, polymorphism and inheritance.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the fundamentals of C++ programming language.	K1
2	Understand the basic concepts of object-oriented programming.	K2
3	Analyze and become proficient in OOP concepts ranging from C++ tokens to inheritance.	K3, K4
4	Use the concepts of objects, operator overloading and inheritance while programming in C++.	K5
5	Create classes and inherit them in defining new derived classes.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Principles of Object-Oriented Programming	6 hours

Software crisis – Software evolution – A look at procedure-oriented programming – Object-oriented programming paradigm – Basic concepts of object-oriented programming – Benefits of OOP – Object-oriented languages – Applications of OOP.

Unit:2	Tokens, Expressions and Control Structures	8 hours

Introduction – Tokens – Keywords – Identifiers and constants – Basic data types – User-defined data types - Derived data types – Symbolic constants – Type compatibility – Declaration of variables – Dynamic initialization of variables – Reference variables – Operators in C++ - Scope resolution operator – Member dereferencing operators – Memory management operators – Manipulators – Type cast operator – Expressions and their types– Special assignment expressions – Implicit conversions – Operator overloading – Operator precedence – Control structures.

Unit:3	Functions in C++ and Managing Console I/O Operations	7 hours

Functions in C++: Introduction – The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Default arguments – Constant arguments – Function overloading – Friend and virtual functions – Math library functions. Managing console I/O operations: Introduction – C++ streams – C++ stream classes – Unformatted I/O operations – Formatted console I/O operations – Managing output with manipulators.

Unit:4	**Classes and Objects**	**7 hours**
Introduction – C Structures revisited – Specifying a class – Defining member functions – A C++ program with class – Making an outside function inline – Nesting of member functions – Private member functions – Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Objects as function arguments – Friendly functions – Returning objects – Constant member functions.		
Unit:5	**Operator Overloading, Type Conversions and Inheritance**	**7 hours**
Operator overloading and type conversions: Introduction – Defining operator overloading – Overloading unary operators – Overloading binary operators – Overloading binary operators using friends – Manipulating of strings using operators – Rules of overloading operators. Inheritance and extending classes: Introduction – Defining derived classes – Single inheritance – Making a private member inheritable – Multilevel inheritance – Multiple inheritance – Hierarchical inheritance – Hybrid inheritance.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture Hours	**37 hours**

Text Book:

1	E. Balagurusamy, Object Oriented Programming with C++, Fifth Edition, Tata McGraw-Hill, New Delhi, 2021.

Reference Books:

1	H. Schildt, C++ – The Complete Reference, Tata McGraw-Hill, New Delhi, 2017.
2	B. Stroustrup, The C++ Programming Language, Addison Wesley, Michigan, 2013.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.edx.org/course/introduction-to-c-3
2	https://www.edx.org/course/intermediate-c-2
3	https://www.edx.org/course/advanced-c

Course Designed By: **Dr. N. NITHYADEVI**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	M	M
CO3	S	S	S	S	S	S	M
CO3	S	S	M	M	S	M	S
CO4	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	25AMAA13P	Practical I : Programming in C++	L	T	P	C
Core/Elective/Supportive		Core	-	-	4	2
Pre-requisite		Basic computer programming knowledge.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. To perform object oriented programming to develop solution to problems demonstrating the usage of objects as instances of classes and data members, to implement various member functions and manage I/O operation.
2. Develop programming skills using C++ and its object oriented concepts.
3. Provide an effective computability using programming in C++.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Write programs in C++ to solve mathematical problems.	K6
2	Do effective computability using programming in C++.	K5
3	Know fundamentals of C++ programming language with the means of writing efficient, maintainable and portable code for numerical problems.	K1, K2
4	Write programs in C++ to solve mathematical problems.	K3
5	Write programs from the underlying algorithms, and demonstrate the ability to employ good commenting and coding techniques.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Course Content

1. Transpose of a Matrix.
2. Obtaining Eigenvalue and Eigenvector of a Matrix.
3. Solving a Transcendental Equation using Newton Raphson Method.
4. Solving a set of Simultaneous Equations by Gauss Elimination Method.
5. Solving a set of Simultaneous Equations by Gauss Jacobi Method.
6. Integration using Trapezoidal Rule.
7. Solving First Order ODE using Second Order Runge-Kutta Method.

Total Practical Hours **37 hours**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/101/106101208/
2	https://nptel.ac.in/courses/106/105/106105151/
3	https://www.edx.org/course/c-programming-c

Course Designed By: **Dr. N. NITHYADEVI**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	M	M
CO3	S	S	S	S	S	S	M
CO3	S	S	M	M	S	M	S
CO4	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA1EA**	**NUMERICAL ANALYSIS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Knowledge about solving algebraic and transcendental equations, differential equations, polynomials, definite integrals of functions etc.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Improve the understanding of the several errors and approximation in numerical methods.
2. Develop numerical computational skills and study their applications. This course focuses on the topics interpolation by polynomials, the solution of nonlinear equations, numerical differentiation and numerical integration.
3. Improve the student's skills in numerical methods by using the numerical analysis software and computer facilities.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Perform the convergence analysis of these techniques and explain different types of errors which gets involved and propagate during numerical computations.	K1, K2
2	Construct polynomial and piecewise polynomial interpolants of functions of one or two variables in a variety of ways including Lagrange interpolants, divided differences.	K6
3	Design, investigate and implement numerical methods for solving different types of problems like initial and boundary value problems of ordinary and partial differential equations.	K4
4	Determine the numerical integration and differentiation by using some basic rules.	K5
5	Create, select and apply appropriate numerical techniques with the understanding of their limitations so that any possible modification in these techniques could be carried out in further research.	K3, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Solving Nonlinear Equations**	**15 hours**

Newton's method – Convergence of Newton's method – Fixed point iteration. Numerical differentiation and integration: derivatives from differences tables – Higher-order derivatives –

Divided difference, Central difference formulas – The trapezoidal rule – A composite formula – Romberg integration – Simpson's rules.		
Unit:2	**Solving Set of Equations:**	**14 hours**
The elimination method – Gauss and Gauss Jordan methods – LU decomposition method – Matrix inversion by Gauss-Jordan method – Method of iteration – Jacobi and Gauss Seidel iteration.		
Unit:3	**Solution of Ordinary Differential Equations:**	**15 hours**
Taylor series method – Euler and modified Euler methods – Runge-Kutta methods – Multistep methods – Milne's method – Adams-Moulton method.		
Unit:4	**Boundary Value Problems and Characteristic Value Problems**	**15 hours**
The shooting method – Solution through a set of equations – Derivative boundary conditions – Characteristic-value problems – Eigen values of a matrix by iteration – The power method.		
Unit:5	**Numerical Solution of Partial Differential Equations:**	**14 hours**
Representation as a difference equation – Laplace's equation on a rectangular region – Iterative methods for Laplace equation – The Poisson equation – Derivative boundary conditions – Solving the equation for time-dependent heat flow (i) The explicit method (ii) The Crank Nicolson method – Solving the wave equation by finite differences.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Seventh Edition, Addison Wesley, Paris, 1998.

Reference Books:

1	M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, Fourth Edition, New Age International (P) Ltd, New Delhi, 2003.
2	C.E. Froberg, Introduction to Numerical Analysis, Second Edition, Addison-Wesley, London, 1972.
3	Azmy S. Ackleh , Edward James Allen , R. Baker Kearfott , Padmanabhan Seshaiyer, Classical and Modern Numerical Analysis: Theory, Methods and Practice, CRC Press, London, 2021.

Related Online Contents

1	https://swayam.gov.in/nd2_cec20_ma11/preview
2	https://nptel.ac.in/courses/111/106/111106101/

3	http://www.math.ust.hk/~mamu/courses/231/hom.htm
Course Designed By: **Dr. N. NITHYADEVI**	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	**25AMAA1EB**	**MATHEMATICAL STATISTICS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Basic knowledge on statistics at UG level and Integral Calculus.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Introduce the basic concepts of probability, random variables and mathematical expectations.
2. Impart the knowledge of probability and the standard statistical distributions.
3. Communicate several statistical techniques from both applied and theoretical points of view.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Explain the concepts of random variable, probability distribution, distribution function, expected value, variance and higher moments, and calculate expected values and probabilities associated with the distributions of random variables.	K1
2	Describe the different types of discrete and continuous distributions and their utilization.	K4
3	Understand mathematical expectations, marginal and conditional distributions, the gamma and chi-square distributions, the t & F distributions and their applications, moment generating function technique and the Central Limit Theorem.	K2
4	Calculate probabilities and quantiles for sampling distributions related to the normal distribution (t, chi-square, F); apply the Central limit theorem to calculate probabilities and quantiles for the sample mean.	K5
5	Apply the knowledge of statistical techniques in various experimental and industrial requirements.	K3, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Distributions of Random Variables	14 hours
The probability set function – Random variables – Probability density function – Distribution function – Mathematical expectation – Special mathematical expectations – Chebyshev's inequality.		
Unit:2	**Conditional Probability and Stochastic Independence**	**15 hours**
Conditional probability – Marginal and conditional distributions – Stochastic independence. **Some Special Distributions:** The Binomial, Trinomial and Multinomial distributions – The Poisson distribution.		
Unit:3	**Some Special Distributions**	**16 hours**
The Gamma and Chi-Square distributions – The normal distribution- The bivariate normal distribution. **Distributions of Functions of Random Variables -** Sampling theory – Transformations of variables of the discrete type – Transformations of variables of the continuous type.		
Unit:4	**Distributions of Functions of Random Variables**	**15 hours**
The χ^2, t and F distributions – Distributions of order statistics – The moment generating function technique. The distributions of χ^2 and nS^2/σ^2 – Expectations of functions of random variables.		
Unit:5	**Limiting Distributions**	**13 hours**
Limiting distributions, Stochastic convergence – Limiting moment generating functions – The Central limit theorem – Some theorems on limiting distributions.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	Robert V. Hogg and Allen T. Craig, Introduction to Mathematical Statistics, Fourth Edition, Macmillan Publishing Company, New York, 1978.

Reference Books:

1	M. Fisz, Probability Theory and Mathematical Statistics, John Wiley & Sons, New York, 1963.
2	J.E. Freund, Mathematical Statistics, Fifth Edition, Prentice Hall of India, New Delhi, 2001.
3	E.J. Dudewicz and S.N. Mishra, Modern Mathematical Statistics, John Wiley & Sons, New York, 1988.
4	V.K. Rohatgi, An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Limited, New Delhi, 1988.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.adelaide.edu.au/course-outlines/102832/1/sem-1/
2	https://ocw.mit.edu/courses/mathematics/18-655-mathematical-statistics-spring-2016/
3	https://www.shortcoursesportal.com/studies/75664/mathematical-statistics.html
Course Designed By : **Dr. N. SAKTHIVEL**	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Second Semester

Course code	25AMAA23A	COMPLEX ANALYSIS	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basics of complex numbers - Differentiation and Integration.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of the fundamental concepts of complex analysis such as analytic functions, complex integrals.
2. Teach the concepts of complex integration, conformal maps, harmonic and subharmonic functions, Dirichlets problem, series and product expansions, elliptic functions, and analytical continuation.
3. Motivate with important application of complex analysis is in string theory which studies conformal invariants in quantum field theory.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.	K1
2	Calculate the complex and real integrals using Residue theorem.	K2
3	Know the complex integration, poles, higher derivatives, Schwarz-Christoffel formula, exponentials-The Fourier development - functions of finite order.	K3
4	Apply Mean value property, Conformal mappings of polygons, Elliptic functions Simply Periodic Functions in real problems.	K4
5	Complex integration, poles, Higher derivatives, the zeros of zeta function, obtain essential concepts of complex integration, Riemann mapping, Elliptic functions.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Complex Integration	14 hours

Fundamental Theorems: Line Integrals – Rectifiable arcs – Line integrals as functions of Arcs – Cauchy's theorem for a rectangle – Cauchy's theorem in a disk.

Cauchy's Integral Formula: The index of a point with respect to a closed curve – The integral formula – Higher derivatives.

Local Properties of Analytical Functions: Removable singularities – Taylors's theorem – Zeros and poles – The local mapping – The maximum principle – Chains and cycles.

Unit:2	Complex Integration	16 hours

The Calculus of Residues: Residue theorem - The argument principle – Evaluation of definite integrals.

Harmonic Functions: Definition of harmonic function and basic properties – The mean value property – Poisson's formula.

Unit:3	**Series and Product Developments**	**15 hours**

Power Series Expansions: Weierstrass's theorem – The Taylor series – The Laurent series.

Partial Fractions and Entire Functions: Partial fractions – Infinite products – Canonical products – The Gamma function – Jensen's formula – Hadamard's theorem.

The Riemann Zeta Function: Product development – Extension of $\zeta(s)$ to the whole plane – The zeros of zeta function.

Unit:4	**Conformal Mappings**	**14 hours**

The Riemann Mapping Theorem: Statement and proof – Boundary behavior – Use of the reflection principle.

Conformal Mappings of Polygons: Behavior at an angle – The Schwarz-Christoffel formula – Mapping on a rectangle.

A Closer Look at Harmonic Functions: Functions with mean value property – Harnack's principle.

Unit:5	**Elliptic Functions**	**14 hours**

Simply Periodic Functions: Representation by exponentials – The Fourier development – Functions of finite order.

Doubly Periodic Functions: The period module – Unimodular transformations – The canonical basis – General properties of elliptic functions.

The Weierstrass Theory: The Weierstrass ρ-function – The functions $\zeta(z)$ and $\sigma(z)$ – The differential equation – The modular function $\lambda(\tau)$ – The conformal mapping by $\lambda(\tau)$.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – Webinars.

	Total Lecture Hours	**75 hours**

Text Book:

1	L. V. Ahlfors, Complex Analysis, Third Edition, McGraw Hill Book Company, New York, 2013.

Reference Books:

1	J.B. Conway, Functions of One Complex Variable, Springer - Verlag, New York, 2012.
2	S. Ponnusamy, Foundations of Complex Analysis, Narosa Publishing House, New Delhi, 1995.
3	M.J. Ablowitz, A.S. Fokas, Complex Variables: Introduction and Applications, Second Edition, Cambridge University Press, Cambridge, 2003.
4	V. Karunakaran, Complex Analysis, Second Edition, Alpha Science International Ltd, Harrow, 2005.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/103/111103070/
2	https://www.freebookcentre.net/maths-books-download/Complex-Analysis-by-NPTEL.ht
3	https://swayam.gov.in/nd1_noc20_ma50
Course Designed By: **Dr. N. NITHYADEVI**	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	S	M	M
CO3	M	M	S	S	S	S	S
CO3	S	S	S	S	L	M	S
CO4	S	S	M	S	M	S	S
CO5	M	L	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	**25AMAA23B**	**PARTIAL DIFFERENTIAL EQUATIONS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**4**	**1**	**-**	**4**
Pre-requisite		Basics of multivariable calculus, ordinary differential equations and linear algebra.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Familiarize the students with the fundamental concepts of Partial differential equations which will be used as background knowledge for the specialized courses in any field.
2. Equip students with the concepts of partial differential equations and how to solve linear Partial Differential with different methods.
3. Give the analytical methods for solving Partial Differential Equations like applying Separation of Variables to solve elementary problems in linear second order Partial Differential Equations (heat and wave equations) and integral transforms.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Solve the first-order linear and non-linear PDE's by using Lagrange's and Charpit's methods.	K5
2	Classify second order PDE and solve standard PDE using separation of variable method.	K6
3	Gain knowledge about methods of separation of variables and boundary value problems.	K2

4	Learn about Cauchy problem and homogeneous and non-homogeneous wave equations.	K1
5	Study analysis and applications of finite difference methods and finite element methods for the numerical solutions of various elliptic, hyperbolic and parabolic Partial Differential Equations.	K3, K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Partial Differential Equations of the First Order**	**15 hours**

Partial differential equations – Origins of first order differential equations – Cauchy's problem for first order equations – Linear equations of the first order – Nonlinear partial differential equations of the first order – Cauchy's method of characteristics – Compatible system of first order equations – Charpit's method – Solutions satisfying given condition – Jacobi's method.

Unit:2	**Partial Differential Equations of the Second Order**	**15 hours**

The origin of second order equations – Linear partial differential equations with constant coefficients – Equations with variable coefficients – Separation of variables – The method of integral transforms – Non-linear equations of the second order.

Unit:3	**Laplace's Equation**	**15 hours**

Elementary solutions of Laplace equation – Families of equipotential surfaces – Boundary value problems – Separation of variables – Problems with axial symmetry – The theory of Green's function for Laplace equation.

Unit:4	**The Wave Equation**	**15 hours**

The occurrence of the wave equation in physics – Elementary solutions of the one-dimensional wave equations – Vibrating membrane, Application of the calculus of variations – Three dimensional problem – General solutions of the wave equation.

Unit:5	**The Diffusion Equation**	**13 hours**

Elementary solutions of the diffusion equation – Separation of variables – The use of integral transforms – The use of Green's functions.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – Webinars.

	Total Lecture Hours	**75 hours**

Text Book:

1. I. N. Sneddon, Elements of Partial Differential Equations, Dover Publications, New York, 2006.

Reference Books:

1. M.D. Raisinghania, Advanced Differential Equations, S. Chand and Company Ltd., New Delhi, 2001.

2	K. Sankara Rao, Introduction to Partial Differential Equations, Second Edition, Prentice – Hall of India, New Delhi, 2006.
3	J.N. Sharma and K. Singh, Partial Differential Equations for Engineers & Scientists, Narosa Publishing House, New Delhi, 2001.

Related Online Contents

1	https://www.classcentral.com/course/swayam-partial-differential-equations-17721
2	https://nptel.ac.in/courses/111/103/111103021/#
3	https://swayam.gov.in/nd2_cec20_ma08/preview

Course Designed By : **Dr. N. SAKTHIVEL**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	**25AMAA23C**	**MECHANICS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**4**	**1**	**-**	**4**
Pre-requisite		Knowledge about basic Mathematics and Physics.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Create a foundation for understanding basic principles of mechanics and some classical problems.
2. Learn Lagrangian and Hamiltonian formulations of classical mechanics.
3. Learn the importance and consequences of canonical transformations.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn about mechanical systems, involving a single particle like projectile motion, Simple harmonic motion, pendulum motion, energy and momentum and related problems.	K1
2	Derive Lagrange's equation using elementary calculus as an alternative to the more advanced variational calculus derivation.	K6
3	Characterize the equation of motion for mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.	K3

4	Obtain canonical equations using different combinations of generating functions and subsequently developing Hamilton Jacobi method to solve equations of motion.	K2, K6
5	Use of analytical treatments in checking the numerical models.	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Introductory Concepts**	**16 hours**

The mechanical system – Generalized coordinates – Constraints – Virtual work – Energy and momentum.

Unit:2	**Lagrange's Equations**	**16 hours**

Derivations of Lagrange's equations – Examples – Integrals of the motion.

Unit:3	**Hamilton's Equations**	**15 hours**

Hamilton's principle – Hamilton's equations – Other variational principles.

Unit:4	**Hamilton-Jacobi Theory**	**13 hours**

Hamilton's principal function –The Hamilton-Jacobi equation – Separability.

Unit:5	**Canonical Transformations**	**13 hours**

Differential forms and generating functions – Special transformations – Lagrange and Poisson brackets.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – Webinars.

	Total Lecture hours	**75 hours**

Text Book:

1. D.T. Greenwood, Classical Dynamics, Prentice Hall of India, New Delhi, 1979.

Reference Books:

1. H. Goldstein, C. Poole and J. Safko, Classical Mechanics, Pearson Education, Inc., New Delhi, 2011.
2. J.R. Taylor, Classical Mechanics, University Science Books, Sausalito, 2005.

Related Online Contents

1. https://swayam.gov.in/nd1_noc19_ph15/preview
2. https://www.classcentral.com/course/swayam-theoretical-mechanics-14332
3. https://nptel.ac.in/courses/115/103/115103115/

Course Designed By: **Dr. N. SAKTHIVEL**

Mapping with Programme Outcomes							
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	**25AMAA23D**	**Java Programming**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**2**	**-**	**-**	**2**
Pre-requisite		Basic Computer Languages.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Understand fundamentals of object oriented programming paradigm with thread and Applet concepts.
2. Enhance problem solving and programming skills in java with extensive programming projects.
3. Inculcate the features of Java programming compared to other languages.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquaint multithreaded programming and simple Applet.	K1
2	Use the characteristic of an OOP.	K3
3	Program using Java features and looping, decision making and branching statements.	K2, K6
4	Evaluate the different programming languages.	K5
5	Write codes of practical interest using composition of objects, operator overloading, inheritance and polymorphism.	K4, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Object Oriented Programming and Overview of Java Language**	**7 hours**

Basic concepts of object-oriented programming – Benefits & applications of OOP. Java evolution: Java features – Java and C – Java and C++ – Java and internet – Overview of Java language: Introduction – Implementation of Java program – Creating, compiling, running the program, Java virtual machine.

Unit:2	**Data Types, Operations, Expressions, Decision Making, Branching and Looping**	**7 hours**

Data types – Operators and expressions – Arrays – Strings – Decision making with if statement, if…else statement, nesting if…else statement, the elseif ladder, switch statement. The while statement, do statement, for statement – Jumps in loops – Labeled loops.		
Unit:3	**Classes, Objects and Input/Output Files**	**7 hours**
Introduction: Defining a class – Fields declaration – Creating objects – Accessing class members – Constructors – Methods overloading – Inheritance – overriding methods – Visibility control – Rules of thumb – Input/Output – Reading/Writing.		
Unit:4	**Packages and Multi-Threaded Programming**	**7 hours**
Packages – Creating threads, extending the thread class – Stopping and blocking a thread – Life cycle of a thread.		
Unit:5	**Applet**	**7 hours**
Introduction – Preparing to write Applets – Building Applet code – Applet life cycle – Creating an executable Applet – Passing parameters to Applets – Displaying numerical values – Getting input from the user.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**37 hours**

Text Book:

1	E. Balagurusamy, Programming with JAVA a Primer, Third Edition, Tata McGraw-Hill, New Delhi, 2014.

Reference Books:

1	M. Siple, The Complete Guide to JAVA Database Programming, Tata McGraw-Hill, New York, 1998.
2	P. Koparkar, JAVA for you, Tata McGraw-Hill, New Delhi, 2001.
3	H. Schildt, The Complete Reference - Java 2.0, Fourth Edition, Tata McGraw-Hill, Berkeley, 2001.
4	K. Arnold, J. Goslings and D. Holmes, The JAVA Programming Language, Addison Wesley, New Jersey, 2005.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.edx.org/professional-certificate/uc3mx-introduction-java-programming
2	https://www.edx.org/course/java-programming-fundamentals
3	https://swayam.gov.in/nd2_aic20_sp13/preview

Course Designed By: **Dr. N. NITHYADEVI**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	S	S
CO3	S	S	S	M	M	M	M
CO3	S	S	S	S	S	S	S
CO4	S	S	M	M	M	M	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA23P**	**Practical II : Java Programming**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**-**	**-**	**4**	**2**
Pre-requisite		C, C++ Programming.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Understand fundamentals of object oriented programming paradigm with thread and Applet concepts.
2. Enhance problem solving and programming skills in java with extensive programming projects.
3. Inculcate the features of Java programming compared to other languages.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Acquaint multithreaded programming and simple Applet.	K1
2	Use the characteristic of an OOP.	K3
3	Program using Java features and looping, decision making and branching statements.	K2, K6
4	Evaluate the different programming languages.	K5
5	Write codes of practical interest using composition of objects, operator overloading, inheritance and polymorphism.	K4, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Course Content

1. Mathematical Operations.
2. Matrix Manipulation.
3. Student Mark List using Multilevel Inheritance.
4. Employee Details using Multiple Inheritance.
5. Packages.
6. Constructors.
7. Thread.
8. Thread using Run Able Interface.

9. Applet. 10. Displaying Different Shapes using Applet.	
Total Practical Hours	**37 hours**
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.edx.org/course/learn-to-program-in-java-2
2	https://swayam.gov.in/nd1_noc20_cs58/preview
3	https://nptel.ac.in/courses/106/105/106105191/
Course Designed By: **Dr. N. NITHYADEVI**	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	M	M	M	M
CO3	S	S	S	S	S	S	M
CO3	S	S	M	M	S	M	S
CO4	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA2EC**	**LINEAR ALGEBRA**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Basics of Linear equations and matrix theory.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are:

1.To develop a strong foundation in linear algebra that provide a basic for advanced studies not only in mathematics but also in other branches like engineering, physics and computers, etc.

2. Particular attention is given to canonical forms of linear transformations, diagonalizations of linear transformations and determinants.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain knowledge on advanced concept of Linear Transformation, Algebra of polynomials determinants and Jordan Canonical forms.	K1, K2
2	Apply linear algebra for solving many problems on Applied Mathematics.	K6
3	Find the minimal polynomials, Jordan forms and the rational forms of real matrices.	K4
4	Compose clear and accurate proofs using the concepts of Linear algebra.	K5
5	Demonstrate competence with the basic ideas of Linear algebra including diagonalization.	K3, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Linear Transformations**	**14 hours**
Linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals.		
Unit:2	**Polynomials**	**14 hours**
The algebra of polynomials – Polynomial ideals – The prime factorization of a polynomial.		
Unit:3	**Determinants**	**15 hours**
Determinant functions - Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials.		
Unit:4	**Elementary Canonical Forms**	**15 hours**
Invariant subspaces – Simultaneous triangulations – Simultaneous diagonalization – Direct-sum decompositions – Invariant direct sums – Primary decomposition theorem.		
Unit:5	**The Rational and Jordan forms**	**15 hours**
Cyclic subspaces – Cyclic decompositions theorem (statement only) – Generalized Cayley – Hamilton theorem – Rational forms – Jordan forms.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	Kenneth Hoffman and Ray Kunze, Linear Algebra, Second Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, 2013.

Reference Books:

1	M. Artin, Algebra, Prentice-Hall of India Pvt. Ltd., New Delhi, 2005.
2	S.H. Friedberg, A.J. Insel and L.E Spence, Linear Algebra, Fourth Edition, Pearson Education, New Jersey, 2003.
3	G. Strang, Introduction to Linear Algebra, Sixth Edition, Wellesley-Cambridge Press, Wellesley, 2023.
4	S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice-Hall of India Pvt. Ltd, New Delhi, 2021.
5	M. Thamban Nair and A. Singh, Linear Algebra, Springer, Singapore, 2018.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc20_ma54/preview
2	https://swayam.gov.in/nd1_noc20_ma31/preview
3	https://cse.sc.edu/~fenner/csce790/notes/index.html
4	https://swayam.gov.in/nd1_noc20_ma21/preview
5	https://swayam.gov.in/nd1_noc20_ma11/preview

Course Designed By: **Dr. P. JAYARAMAN**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	M	S	S
CO3	S	M	S	S	S	M	S
CO3	S	S	S	S	M	S	S
CO4	M	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA2ED**	**GRAPH THEORY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Basic knowledge of linear algebra.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Impart the knowledge on fundamental mathematical structures used to model pairwise relations between objects.

2. Teach some basic concepts of graph theory including cycles, matchings, colourings, connectivity, and extremal graphs.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Solve problems using basic graph theory and identify induced subgraphs, cliques, matchings, colours in graphs.	K1
2	Determine whether graphs are Hamiltonian and/or Eulerian. Solve problems involving vertex and edge connectivity, planarity and crossing numbers.	K2
3	Formulate and prove central theorems about trees, matching, connectivity, colouring and planar graphs and apply some basic algorithms for graphs.	K3

4	Apply the algorithms that are treated in the course for solving graph theoretical problems.	K4
5	Understand the fundamental properties of some families of random graphs, apply principles and concepts of graph theory in practical situations.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**An Introduction to Graphs**	**16 hours**

Basic concepts – Isomorphism and automorphism –The pigeonhole principle and Turan's theorem – Distance, radius, diameter and girth – Subgraphs and isometric subgraphs –Operations on graphs - The adjacency, incidence and path matrices – Introduction to algorithms – Breadth-first search algorithm – Dijkstra's algorithm – Ford's algorithm.

Bipartite Graphs: Characterizations of bipartite graphs – Trees – Cut edges and cut vertices – Spanning trees and isometric trees – Cayley's formula – Binary trees– Spanning tree algorithm – Kruskal's algorithm – Prim's algorithm.

Unit:2	**Connectivity**	**14 hours**

Connectivity and edge connectivity – 2-Connected graphs – Menger's theorem – Separable graphs, 1-Isomorphism and 2-Isomorphism.

Graphic Sequences: Degree sequences – Graphic sequences – Wang and Kleitman's theorem – Haval & Hakimi algorithm – Generalisation of Haval & Hakimi algorithm.

Unit:3	**Eulerian and Hamiltonian Graphs**	**16 hours**

Characterizations of Eulerian graphs – Randomly Eulerian graphs – Application – Algorithm – Fleury's algorithm –Hamiltonian graphs – Hamilton cycle in power graphs and line graphs – Hamiltonian sequences – Application –Two optimal algorithm – The closest insertion algorithm – Albertson's algorithm.

Matchings: Matching – System of distinct representatives and marriage problem – Covering – Konig-Egervary theorem - 1-Factor - Tutte's theorem – Stable matchings – Application – The Hungarian algorithm – Algorithm for maximum matching.

Unit:4	**Independence**	**14 hours**

Independent sets – Edge colourings – Application – Vizing's theorem – Vertex colouring – Uniquely colourable graphs – Brook's bound and improvements – Hajos conjecture – Mycielski's construction – Line-distinguishing colourings – Chromatic polynomials – Sequential colouring algorithm.

Unit:5	**Planar Graphs**	**13 hours**

Planar embedding – Euler's formula – Maximum planar graphs – Geometric dual – Characterizations of planar graphs – DMP planarity algorithm – Colouring in planar graphs – Face colouring.

Unit:6	Contemporary Issues	2 hours
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	M. Murugan, Graph Theory and Algorithms, Second Edition, Muthali Publishing House, Chennai, 2018.

Reference Books:

1	J.A. Bondy and U.S.R. Murty, Graph Theory with Applications, Macmillan Co., London, 1976.
2	R. Balakrishnan and K. Ranganathan, A Textbook of Graph Theory, Springer, New York, 2012.
3	D.B. West, Introduction to Graph Theory, Pearson Education, New Delhi, 2002.
4	J. Clark and D.A. Holton, A First Look at Graph Theory, Allied Publishers, New Delhi, 1995.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.swayam2.ac.in/cec20_ma03/preview
2	https://is.muni.cz/course/fi/autumn2017/MA010
3	https://www.math.kit.edu/iag6/edu/graphtheory2019w/en

Course Designed By: **Dr. P. JAYARAMAN**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Third Semester

Course code	25AMAA33A	Topology	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basic real analysis and group theory.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce the fundamental concepts of topology and investigate the properties of topological spaces.
2. Educate the fundamental theorems of topological spaces that find applications in other branches of mathematics.
3. Inculcate the importance of topological properties when studying a problem in functional setting.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the various topological properties of sets.	K1
2	Understand the properties of continuous functions on different topological spaces.	K2
3	Analyze various theorems on normal spaces and complete metric spaces.	K3, K4
4	Work with mathematical problems in connected and compact topological spaces.	K5
5	Come up with new topological spaces to fit in mathematical needs.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Topological Spaces	15 hours

Topological spaces – Basis for a topology – The order topology – The product topology on X x Y – The subspace topology – Closed sets and limits points.

Unit:2	Continuous Functions	14 hours

Continuous functions – The product topology **–** The metric topology – Sequence lemma – Uniform limit theorem.

Unit:3	Connectedness and Compactness	15 hours

Connected spaces – Connected subspaces of the real line – Compact spaces – Compact subspaces of the real line – Uniform continuity theorem.

Unit:4	Countability and Separation Axioms	14 hours

Limit point compactness – The countability axioms – Lindelof and separable spaces – The separation axioms.

Unit:5	Normal and Regular Spaces	15 hours

Normal spaces – The Urysohn lemma – The Urysohn metrization theorem – Tietze extension theorem – The Tychonoff theorem.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	James R. Munkres, Topology, Second Edition, Prentice – Hall of India, New Delhi, 2015.

Reference Books:

1	G.F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw-Hill Edition, New Delhi, 2004.
2	Fred H. Croom, Principles of Topology, Cengage India Pvt Ltd, New Delhi, 2009.
3	Seymour Lipschutz, Theory and Problems of General Topology, McGraw-Hill Edition, New Delhi, 2006.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/1565
2	https://nptel.ac.in/courses/111/106/111106054/
4	https://ocw.mit.edu/courses/mathematics/18-901-introduction-to-topology-fall-2004/

Course Designed By: **Dr. M. SUVINTHRA**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	M	S	S	S
CO3	S	S	S	S	S	M	S
CO3	S	S	S	M	M	S	S
CO4	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	25AMAA33B	Fluid Dynamics	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basic Mechanics.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce fundamental aspects of fluid flow behavior.
2. Motivate the students with immense applications of the study in aerodynamics.
3. Promote the theoretical analysis of fluid flow behavior reducing cost in comparison with experimental set up.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Use the general energy equation to calculate changes in fluid flow for circular and non-circular pipes for in-compressible fluids.	K2
2	Identify how properties of fluids change with temperature and their effect on pressure and fluid flow.	K3
3	Grasp the concepts of viscosity and its effect in fluid flow.	K1
4	Analyze the flow of fluid using its generalized mathematical model – the Navier Stokes equation.	K4, K5
5	Model a fluid flow phenomena using Navier-Stokes equation under ideal situations.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Bernoulli's Equation	15 hours

Introductory notions – Velocity – Streamlines and path of the particles – Stream tubes and filaments – Fluid body – Density – Pressure – Differentiation following the fluid – Equation of continuity – Boundary Conditions – Kinematical and physical – Rate of change of linear momentum – Equation of motion of an inviscid fluid.

Unit:2	Equations of Motion	14 hours

Euler's momentum theorem – Conservative forces – Bernoulli's theorem in steady motion – energy equation for inviscid fluid – circulation – Kelvin's theorem – Vortex motion – Helmholtz equation.

Unit:3	Two Dimensional Motion	15 hours

Two dimensional potential functions – Complex basic singularities – Source-sink-vortex-Doublet-past a circle theorem – Flow circular cylinder with circulation – Blasius theorem – Lift force (Magnus effect).

Unit:4	Viscous Flows	14 hours

Navier-Stokes equations – Some exact solutions of Navier-Stokes equations – Flow between parallel flat plates – Couette flow – Plane Poiseuille flow – Steady flow in pipes: Flow through a pipe – The Hagen Poiseuille flow.		
Unit:5	**Laminar Boundary Layer in Incompressible Flow**	**15 hours**
Boundary layer concept – Boundary layer equations – Boundary layer along a flat plate – The Blasius solution – Shearing stress and boundary layer thickness – Displacement thickness, momentum thickness – Momentum integral theorem for the boundary layer – The Von-Karman integral relation – The Von-Karman integral relation by momentum law.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Books:

1	L.M. Milne-Thomson, Theoretical Hydrodynamics, Fifth Edition, Macmillan Company, London, 1968.
2	N. Curle and H.J. Davies, Modern Fluid Dynamics, Vol-I, Incompressible flow, David Van Nostrand Company, London, 1968.
3	S. W. Yuan, Foundations of Fluid Mechanics, Prentice – Hall, New Delhi, 1976.

Reference Books:

1	F. Chorlton, Textbook of Fluid Dynamics, CBS Publishers & Distributors, New Delhi, 2004.
2	E. Krause, Fluid Mechanics with Problems and Solutions and an Aerodynamics Laboratory, Springer, Berlin, 2005.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.edx.org/course/hydraulics
2	https://www.edx.org/course/introduction-to-aerodynamics-2
3	https://nptel.ac.in/courses/101/103/101103004/
4	https://swayam.gov.in/nd1_noc20_me82/preview

Course Designed By: **Dr. N. NITHYADEVI**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	M	S
CO3	S	S	S	S	M	S	S
CO3	S	S	M	S	S	S	S
CO4	S	S	S	M	S	S	S
CO5	S	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

Course code	25AMAA33C	MATHEMATICAL METHODS	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basic concepts of calculus, initial value problems, boundary value problems and linear transformations.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce the basic concepts and knowledge about different types of integral equations and its applications.
2. Gain the key concept of popular and useful transformations techniques like Fourier transform and Hankel transform.
3. To lay a broad foundation for an understanding of the problems of the calculus of variations and its various methods and techniques.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Familiarize and understand the Volterra and Fredholm integral equations and their solutions using various methods.	K1
2	Solve simple IVP and BVP by using calculus of several variables.	K4
3	Apply techniques of Integral transform to formulate and solve complex problems of differential equations.	K3
4	Solve the equations involving functional and parametric form.	K2
5	Solve applied problems of science and engineering by using learned mathematical methods.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Integral Equations	16 hours

Introduction: Integral equations with separable kernels – Reduction to a system of algebraic equations – Fredholm alternative – An approximate method – Fredholm integral equations of the first kind – Method of successive approximations – Iterative scheme – Volterra integral equation – Some results about the resolvent kernel – Classical Fredholm theory – Fredholm's method of solution – Fredholm's first, second, third theorems.

Unit:2	Applications of Integral Equations	13 hours

Application to ordinary differential equation – Initial value problems – Boundary value problems – Singular integral equations – Abel integral equation.

Unit:3	Fourier Transforms	14 hours

Fourier transforms, Fourier sine and cosine transforms – Fourier transforms of derivatives – convolution integral – Parseval's theorem - Solution of Laplace equations by Fourier transform.

Unit:4	Hankel Transforms	16 hours
Properties of Hankel transforms – Hankel transformation of derivatives of functions – The Parseval's relation – relation between Fourier and Hankel transforms - Axisymmetric Dirichlet problem for a half space – Axisymmetric Dirichlet problem for a thick plate.		
Unit:5	**Calculus of Variations**	**14 hours**
The method of variations in problems with fixed boundaries: Variation and its properties - Euler's equation - Functionals of the form $\int F(x,y_1,y_2,..., y_n,y_1',y_2',...y_n')dx$ – Functionals dependent on higher order derivatives – Functionals dependent on the functions of several independent variables – Variational problems in parametric form – Some applications.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Books:

1	R.P. Kanwal, Linear Integral Equations: Theory and Technique, Second Edition, Birkhauser, Boston, 2013.
2	I.N. Sneddon, The Use of Integral Transforms, Tata Mc Graw Hill, New Delhi, 1974.
3	L. Elsgolts, Differential Equations and the Calculus of Variations, MIR Publishers, Moscow, 1977.

Reference Books:

1	M. Rahman, Integral Equations and their Applications, WIT Press, Boston, 2007.
2	L. Debnath and D. Bhatta, Integral Transforms and their Applications, Taylor & Francis Group, London, 2007.
3	B.V. Brunt, The Calculus of Variations, Springer-Verlag, New York, 2004.
4	I.M. Gelfand and S.V. Fomin, Calculus of Variations, Dover Publications, New York, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/107/111107103/
2	https://nptel.ac.in/courses/111/104/111104025/
3	https://nptel.ac.in/courses/111/102/111102129/

Course Designed By: **Dr. R. SAKTHIVEL**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	25AMAA33D	MATLAB	L	T	P	C
Core/Elective/Supportive		Core	2	-	-	2
Pre-requisite		Basics of applied Mathematics: calculus, linear algebra, and differential equations.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Provides basic fundamentals on MATLAB, be able to write basic Matlab code, primarily for numerical computing.
2. Learn the characteristics of script files, functions and function files, two-dimensional plots and three-dimensional plots.
3. Develop the programming skills with the help of MATLAB and its features which allow to learn and apply specialized technologies.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Define matrices, extract parts of them and combine them to form new matrices.	K3
2	Learn how to use the for-loop and the while-loop.	K1
3	Realize the necessity for simulation /execution for the verification of mathematical functions.	K2, K4
4	Appliance simple mathematical functions/equations in numerical computing atmosphere such as MATLAB.	K5
5	Interpret and visualize simple mathematical functions and operations thereon using plots/display.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction	7 hours

Introduction - Basics of MATLAB, Input – Output, File types – Platform dependence – General commands.

Unit:2	Interactive Computation	7 hours

Matrices and vectors – Matrix and array operations – Command-line functions – Using built-in functions and on-line help – Saving and loading data – Plotting simple graphs.

Unit:3	Programming in MATLAB: Scripts and Functions	7 hours

Script files – Function files – Language-specific features – Advanced data objects.

Unit:4	Applications: Algebraic Equations and Statistics	7 hours

Linear algebra – Solving a linear system – Gaussian elimination – Finding eigenvalues and eigenvectors – Matrix factorizations – Nonlinear algebraic equations – Statistics.

Unit:5	**Applications: Differential Equations**	**7 hours**
Numerical integration – Solution of ordinary differential equations for initial value problems – Solution of ordinary differential equations for boundary value problems.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**37 hours**

Text Book:

1	Rudra Pratap, Getting Started with MATLAB - A Quick Introduction for Scientists and Engineers, Seventh Edition, Oxford University Press, New York, 2017.

Reference Books:

1	D.M. Etter and D.C. Kuncicky, Introduction to MATLAB 7, Prentice Hall, New Jersey, 2005.
2	W.J. Palm, Introduction to Matlab 7 for Engineers, McGraw-Hill Education, New York, 2005.
3	A. Gilat, MATLAB An Introduction with Application, John Wiley & Sons, Singapore, 2016.

Related Online Contents

1	https://nptel.ac.in/courses/103/106/103106074/
2	https://nptel.ac.in/courses/103/106/103106118/
3	https://www.classcentral.com/course/swayam-matlab-programming-for-numerical-computation-5303

Course Designed By: **Dr. N. SAKTHIVEL**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	25AMAA33D	Practical III : MATLAB	L	T	P	C
Core/Elective/Supportive		Core	-	-	4	2
Pre-requisite		Basic programming knowledge.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Provides to write basic MATLAB code, mainly for numerical computing.
2. Training the different plots like two-dimensional plots and three-dimensional plots.
3. To enhance the programming skills with the help of MATLAB and its features which allow to learn and apply specialized technologies.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Write MATLAB coding related to find addition, Multiplication and determinants of matrices.	K2, K3
2	Learn use of for-loop and the while-loop in MATLAB coding,	K1
3	Write MATLAB coding for mathematical functions.	K4
4	Effective computability of numerical computing such as MATLAB,	K5
5	Write MATLAB coding for draw the graph of functions,	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

	Course Content	
1	Matrix formulation by using for loop and if…else condition.	
2	Matrix manipulations.	
3	Displaying a number by using continue, pause and break statements.	
4	Arithmetic operations by using if…elseif condition.	
5	Finding a trigonometric value by using switch statement.	
6	Factorial of a number by using for and while loops.	
7	Plotting a function.	
8	Polar plot.	
9	Straight line fit.	
10	Exponential curve fit.	
11	Solving first order linear ordinary differential equations.	
12	Solving second order non-linear ordinary differential equations.	
13	Solving non-linear algebraic equations.	
	Total Practical Hours	**37 hours**

Related Online Contents

1	https://nptel.ac.in/courses/103/106/103106118/

2	https://swayam.gov.in/nd1_noc20_ma40/preview
Course Designed By: **Dr. N. SAKTHIVEL**	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	**25AMAA3EE**	**FUZZY SETS AND THEIR APPLICATIONS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**-**	**-**	**4**
Pre-requisite		Definitions and concepts of the theory of ordinary sets.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Understand the basic knowledge of fuzzy sets, relations and operations.
2. Acquire sufficient knowledge and skill in the subject that will make them competent in various areas of mathematics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know about fuzzy sets and operations.	K1, K2
2	Be familiarize with fuzzy relations and the properties of these relations.	K3
3	Formulate a system and make a decision in fuzzy environment.	K4
4	Compose clear and accurate proofs using the concepts of fuzzy sets.	K5
5	Apply a new thinking methodology to real life problems including medicine.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Crisp Sets and Fuzzy Sets**	**15 hours**

Overview of classical sets, Membership function, Height of a fuzzy set – Normal and sub normal fuzzy sets – Support – Level sets, fuzzy points, α–cuts – Decomposition Theorems, Extension Principle.

Unit:2	Operation on Fuzzy Sets	15 hours
Standard fuzzy operations – Union, intersection and complement – Properties De. Morgan's laws - α–Cuts of fuzzy operations.		
Unit:3	**Fuzzy Relations**	**16 hours**
Cartesian product, Crisp relations – Cardinality – Operations and properties of crisp and fuzzy relations. Image and inverse image of fuzzy sets – Various definitions of fuzzy operations – Generalizations – Non interacting fuzzy sets, Tolerance and equivalence relations.		
Unit:4	**Decision Making in Fuzzy Environments**	**14 hours**
General discussion – Individual decision making – Multi person decision making – Multi criteria decision making – Multi stage decision making – Fuzzy ranking methods – Fuzzy linear programming.		
Unit:5	**Applications**	**13 hours**
Medicine – Economics – Fuzzy systems and genetic algorithms – Fuzzy regression – Interpersonal communication – Other applications.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	George J. Klir and Bo Yuan, Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Leaning Private Limited, New Delhi , 2009.

Reference Books:

1	H.J. Zimmermann, Fuzzy Set Theory and its Applications, Springer, New York, 2012.
2	T. J. Ross, Fuzzy Logic with Engineering Applications, John Wiley and Sons, Chichester, 2010.
3	J.J. Buckley and E. Eslami, An Introduction to Fuzzy Logic and Fuzzy Sets, Springer-Verlag Heidelberg, 2002.
4	A.K. Bhargava, Fuzzy Set Theory, Fuzzy Logic and their Applications, S. Chand and Company, New Delhi, 2013.
5	S.K. Pundir and R. Pundir, Fuzzy Sets and their Application, A Pragati Edition, Meerut, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc19_ma31/preview
2	https://swayam.gov.in/nd1_noc20_ma48/preview

3	https://swayam.gov.in/nd1_noc20_ee03/preview
4	https://swayam.gov.in/nd1_noc20_ge09/preview
5	https://www.tutorialspoint.com/fuzzy_logic/fuzzy_logic_decision_making.htm
6	https://shodhganga.inflibnet.ac.in/bitstream/10603/139431/17/17%20fuzzy%20logic%20and%20decision%20making.pdf
7	https://www.cc.gatech.edu/~surban6/2018sp-gameAI/lectures/2018_03_15-DecisionMaking_FuzzyLogic.pdf

Course Designed By: **Dr. P.DHANALAKSHMI**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	S	S
CO2	S	S	S	S	S	M	S
CO3	S	S	S	S	S	S	S
CO4	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA3ED**	**Discrete Mathematics**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Logics, Permutations, Relations.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Prepare students to develop mathematical foundations to understand and create mathematical arguments.
2. Motivate students how to solve practical problems using discrete mathematics.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Learn how to work with some of the discrete structures which include sets, relations, function and recurrence relation.	K1
2	Understand how Boolean algebra can be used as a tool and mathematical model in the study of networks.	K2, K4
3	Construct mathematical arguments using logical connectives and quantifiers.	K6
4	Implement the algebraic and discrete mathematical theory in programming automata.	K3, K5
5	Model finite state machines using Boolean algebra.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**The Foundations: Logic and Proofs**	**15 hours**
Propositional logic – Applications of propositional logic – Propositional equivalences – Predicates and quantifiers – Nested quantifiers. Algorithms: The growth of functions.		
Unit:2	**Counting and Advanced Counting Techniques**	**15 hours**
The basics of counting – The Pigeonhole principle – Permutations and combinations – Generalized permutations and combinations – Generating permutations and combinations – Applications of recurrence relations – Solving linear recurrence relations – Generating functions.		
Unit:3	**Boolean Algebra and Modeling Computations**	**15 hours**
Boolean functions – Representing Boolean functions – Logic gates – Minimization of circuits Finite-state machines with output – Finite-state machines with no output – Turing machines.		
Unit:4	**Coding Theory**	**15 hours**
Introduction to coding – Linear codes – Cyclic codes – Special cyclic codes.		
Unit:5	**Further Applications of Algebra**	**13 hours**
Semi group – Semigroup and automata – Semigroup and formal languages – Linear recurring sequences.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	K. H. Rosen, Discrete Mathematics and its Applications, Eighth Edition, McGraw Hill Education, New York, 2019.
2	R. Lidl and G. Pilz, Applied Abstract Algebra, Second Edition, Springer-Verlag, New York, 1998.

Reference Books:

1	A. Doerr and K. Levasseur, Applied Discrete Structures for Computer Science, Galgotia publications, New Delhi, 2000.
2	R. P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education, New York, 2002.
3	J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill, New Delhi, 2008.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc20_cs82/preview
2	https://nptel.ac.in/courses/111/107/111107058/

3	https://nptel.ac.in/courses/111/106/111106086/

Course Designed By: **Dr. M. SUVINTHRA**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	M	S	S	S
CO3	S	S	S	S	S	M	S
CO3	S	S	S	M	M	S	S
CO4	S	S	S	S	S	M	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Fourth Semester

Course code	25AMAA43A	FUNCTIONAL ANALYSIS	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Linear spaces – Bases – Linear transformations. Metric spaces – Completeness – Compactness – Continuous functions.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Introduce the basic concepts and theorems of functional analysis and its significant applications.
2. Enhance research, inquiry and analytical thinking abilities.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Be familiar with Banach spaces and related theorems.	K1
2	Identify the Hilbert spaces orthogonal set.	K3
3	Analyze and Appreciate the significance of Hahn Banach theorem, Open mapping theorem and Uniform boundedness principle.	K2, K4
4	Independently prove and thoroughly explain theorems.	K5
5	Understand the fundamental of spectral theory and realize its uses.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Banach Spaces	15 hours

Normed spaces – Banach spaces and further properties – Continuous linear transformations – Hahn Banach theorem and its consequences.

Unit:2	Fundamental Theorems	15 hours

Dual spaces – The natural embedding of N in N** – Uniform boundedness principle – Open mapping theorem – Closed graph theorem – The conjugate of an operator.

Unit:3	Hilbert Spaces	15 hours

Hilbert space: Definition and properties – Orthogonal complements and direct sums – Orthonormal sets and sequences – Series related to orthonormal sets and sequences – Maximal orthonormal sets and sequences – Projection theorem – Representation of functionals on Hilbert spaces.

Unit:4	Operators on Hilbert Spaces	14 hours

The adjoint of an operator – Self adjoint operator – Normal and unitary operators – Projections – The spectrum of bounded operator – Spectral theorem for normal and self adjoint operators.

Unit:5	**Banach Algebras**	**14 hours**
Introduction to Banach algebras: Definition, examples and some related basic results – Regular and singular elements – The spectrum – The formula for the spectral radius.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill, New Delhi, 2004.

Reference Books:

1	M. T. Nair, Functional Analysis: A First Course, Prentice-Hall of India, New Delhi, 2021.
2	B.V. Limaye, Functional Analysis, Third edition, New Age International, New Delhi, 2017
3	G. Bachman and Lawrence Narici, Functional Analysis, Dover Publications, New York, 2000.
4	E. Kreyszig, Introductory Functional Analysis with Applications, Wiley India Private Limited, Noida, 2007.
5	E.S. Suhubi, Functional Analysis, Springer International, New Delhi, 2009.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111105037/
2	https://nptel.ac.in/courses/111/106/111106047/
3	https://ocw.mit.edu/courses/mathematics/18-102-introduction-to-functional-analysis-spring-2009/lecture-notes/
4	http://home.iitk.ac.in/~chavan/fa_mth405_1.pdf

Course Designed By: **Dr. M. SUVINTHRA**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	M	S	S	M
CO3	S	S	S	M	S	M	S
CO3	S	M	S	M	S	S	S
CO4	S	S	M	M	S	S	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	25AMAA43B	OPTIMIZATION TECHNIQUES	L	T	P	C
Core/Elective/Supportive		Core	4	1	-	4
Pre-requisite		Basics of linear algebra, calculus, probability and statistics.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Compute the essential knowledge of Linear Programming and Dynamic Programming problems
2. Provide the depth knowledge about inventory control theory and make students to solve the inventory problems.
3. Learn classical optimization techniques and numerical methods of optimization.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Investigate the real life organizations with limited constraints and describe the systems in a mathematical model form.	K1
2	Estimate basics of integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.	K2
3	Solve multi-level decision problems using dynamic programming method.	K3
4	Understanding the basic concepts of optimization techniques, inventory and queuing theory.	K4
5	Becomes a thorough knowledge on constrained nonlinear programming and dynamic programming, use optimization techniques to solve many practical problems.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Network Models	14 hours

Network problems: Preliminary ideas – Network linear programme – Ensuring total supply equals total demand – Transportation problem – Assignment problem – Shortest route problem – Maximum flow problem cuts in a network.

Unit:2	Integer Programming	16 hours

Introduction – Integer programming formulations – Gomory's construction – Fractional cut method (all integer) – The Cutting-Plane algorithm – Branch and bound technique – Zero–One implicit enumeration algorithm.

Unit:3	Dynamic Programming	15 hours

Introduction – The recursive equation approach – Characteristics of dynamic programming – Dynamic programming algorithm – Solution of discrete D.P.P – Some applications – Solution of L.P.P by dynamic programming.

Unit:4	Inventory	14 hours

Inventory: Introduction – Inventory decisions – Cost associated with inventories – Factors affecting inventory – Economic order quantity – Deterministic inventory problems with no shortages – Deterministic inventory models with shortages – EOQ with price breaks – Multi item deterministic problems – Inventory problems with uncertain demand.		
Unit:5	**Queuing Theory**	**14 hours**
Introduction – Queuing system – Elements of queuing system – Operating characteristics of queuing system – Classification of queuing models–Model–I(M/M/1):(∞/FIFO), Model–II(M/M/1):(N/FIFO), Model–III(M/M/C):(∞/FIFO), Model–IV(M/M/C):(N/FIFO): Problems in above four models.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Books:	
1	Hamdy A. Taha, Operations Research, Eighth Edition, Prentice–Hall of India private Limited, New Delhi, 2007.
2	Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, Eleventh Edition, Sultan Chand & Sons, New Delhi, 2003.
Reference Books:	
1	P.K. Gupta and D.S. Hira, Operations Research, Seventh Edition, S. Chand & Company, New Delhi, 2014.
2	R. Panneerselvam, Operations Research, Third Edition, PHI Learning Private Limited, New Delhi, 2023.
3	F.S. Hillier and G.J. Lieberman, Introduction to Operation Research, Ninth Edition, Tata–McGraw Hill, New Delhi, 2010.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://swayam.gov.in/nd1_noc19_ma29/preview
2	https://swayam.gov.in/nd1_noc20_ma32
3	https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L1slides.pdf
Course Designed By: **Dr. P. JAYARAMAN**	

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	25AMAA43C	PYTHON PROGRAMMING	L	T	P	C
Core/Elective/Supportive		Core	2	-	-	2
Pre-requisite		Basic computer skills.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Acquire knowledge in Python programming.
2. Develop python programs with control structures in mathematical modeling.
3. Gain knowledge of mathematics and machine learning using python.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Construct and execute basic programs in Python.	K1
2	Apply python library.	K3
3	Implement numerical programming, data handling through numpy, Pandas, scipy modules.	K2, K4
4	Implement visualization through matplotlib.	K6
5	Analyze the significance of python program development environment by working on real world needs.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction	7 hours

Python: Introduction – History of Python – Python features – Python interpreter – Overview of programming in Python – Basic data types Python built in types – Arithmetic in Python – Program input and program output – Variables and assignment: Global and local variables. Modules: Importing module – Math module – Random module – Packages – Composition. Exception handling.

Unit:2	Dictionary	7 hours

Python strings and string manipulation [Assigning values in strings, String manipulations, String special operators, String formatting operators, Triple quotes, Raw string, Unicode string, Build-in-string methods] – Python list: Introduction – Accessing values in list – List manipulations – List operations – Indexing – Slicing & matrices. Python dictionary – Introduction – Accessing values – Properties – Functions in dictionary. Python tuples: Introduction – Operation – Accessing – Function and methods in tuples and data type conversion.

Unit:3	Control Structures	7 hours

Arithmetic operators – Comparison operators – Logical (or relational) operators – Assignment operators – Conditional (or ternary) operators – Conditional statement: Branching (if, else-if,

nested), Looping: while statement – for statements – Control statements: break, continue and pass statements.		
Unit:4	**Python Libraries**	**7 hours**
Functions: Defining a function – Calling a function – Types of functions – Function arguments – Anonymous functions – Regular expressions: Match function – Search function – Modifiers. OOPs concept NumPy [Arrays and matrices]: N-dimensional data structure – Creating array – Indexing array – Reshaping – Vectorized operations.		
Unit:5	**Mathematics in Python**	**7 hours**
Pandas [Data Manipulation]: Create data frame – Combining data frames – Summarizing – Columns selection – Rows selection (basic) – Rows selection (filtering) – Sorting – Descriptive statistics – Rename values – Dealing with outliers SciPy Introduction – Basic functions – Special functions(scipy.special), Integration(scipy.integrate), Optimization(scipy.optimize), Visualization libraries: matplotlib.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**37 hours**

Text Book:

1	Wesley J Chun, Core Python Programming, Second Edition, Prentice-Hall of India, New Delhi, 2007.

Reference Books:

1	Mark Summerfield, Programming in Python 3-A Complete Introduction to Python Language, Second Edition, Addison Wesley, San Francisco, 2010.
2	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, Beijing, 2016.
3	John V Guttag, Introduction to Computation and Programming using Python, The MIT Press, London, 2021.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/106/106106212/
2	https://programming-steps.blogspot.com/2013/10/raptor-flowchart
3	https://wiki.python.org/moin/BeginnersGuide/Download
4	https://nptel.ac.in/courses/106/106/106106145/
5	https://www.edx.org/learn/python

Course Designed By: **Dr. P. DHANALAKSHMI**

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	S	S	M	M	M	M
CO2	S	S	M	M	M	S
CO3	S	S	M	M	S	M
CO4	S	S	S	S	S	S
CO5	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA43P**	**Practical IV: Programming in Python**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**-**	**-**	**4**	**2**
Pre-requisite		Basic computer knowledge- Programming concepts.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. To perform object oriented programming to develop solution to problems demonstrating the usage of functions and methods.
2. Provide an effective computability and develop programming skills using python.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Write programs from the underlying algorithms, and demonstrate the ability to employ good commenting and coding techniques.	K1, K3
2	Understand the various data structures available in Python programming language and apply them in solving computational problems.	K2, K3
3	Do testing and debugging of code written in Python.	K4
4	Plot graphs related to mathematical problems using python library.	K5
5	Build frames with scipy.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Course Content

1. Demonstrate use of strings in python.
2. Demonstrate use of different types of structures (list, dictionary, tuples) in python.
3. Develop programs to understand the control structures of python.
4. Demonstrate handling of missing data.
5. Develop programs for data structure algorithms using python – searching, sorting and hash tables.
6. Demonstrate use of SciPy in python.
7. Learn to plot different types of graphs using matplotlib.

Total Lecture hours **37 hours**

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://docs.python.org/3/tutorial/index.html
2	https://www.python.org/doc/
Course Designed By: **Dr. P. DHANALAKSHMI**	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	M	M	M	M
CO2	S	S	S	S	S	S	M
CO3	S	S	M	M	S	M	S
CO4	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

Course code	**25AMAA4EG**	**CONTROL THEORY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Basic concepts from matrix, functional analysis and ordinary differential equations.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Understand the fundamentals of physical systems in terms of its linear and nonlinear models.
2. Exploit the qualitative properties of systems such as controllability, observability, stability and stabilizability.
3. Learn the concepts for design of state feedback and optimal controllers for linear and nonlinear systems

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Use mathematical techniques to formulate and solve physical problems.	K1
2	Use the learned techniques to assess the stability, controllability, and observability of certain class of linear and non-linear systems.	K2
3	Design the state feedback and optimal controllers for linear and nonlinear systems.	K5
4	Analyze the optimal control for time-variant and time invariant systems.	K4
5	Apply knowledge of control theory to practical engineering problems.	K3,K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Observability**	**15 hours**

Linear systems – Observability Grammian – Constant coefficient systems – Reconstruction kernel – Nonlinear systems.

Unit:2	**Controllability**	**15 hours**
Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems– Steering function – Nonlinear systems.		
Unit:3	**Stability**	**14 hours**
Stability – Uniform stability – Asymptotic stability of linear systems - Linear time-varying systems – Perturbed linear systems – Nonlinear systems.		
Unit:4	**Stabilizability**	**15 hours**
Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback.		
Unit:5	**Optimal Control**	**14 hours**
Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear systems.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**75 hours**

Text Book:

1	K. Balachandran and J.P. Dauer, Elements of Control Theory, Second Edition, Narosa Publishing House, New Delhi, 2012.

Reference Books:

1	J.P. Hespanha**,** Linear Systems Theory, Princeton University Press, New Jersey, 2009.
2	W. Krabs and S. Pickl, Dynamical Systems: Stability, Controllability and Chaotic Behavior, Springer-Verlag, Berlin, 2010.
3	M.C. Joshi**,** Ordinary Differential Equations: Modern Perspective, Alpha Science Intl. Ltd., Mumbai, 2006.
4	C.T. Chen, Linear System Theory and Design, Third Edition, Oxford University Press, New York, 1999.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/107/111107118/·
2	http://www.math.iitb.ac.in/~neela/CIMPA/notes/CIMPA_RKG.pdf
3	http://maecourses.ucsd.edu/~mdeolive/mae280b/lecture/lecture1.pdf
4	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-241j-dynamic-systems-and-control-spring-2011/readings/MIT6_241JS11_chap24.pdf

Course Designed By: **Dr. R. SAKTHIVEL**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	**25AMAA4EH**	**Elements of Stochastic Processes**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**1**	**-**	**4**
Pre-requisite		Basic concepts of probability theory.	**Syllabus Version**		**2025-2026**	

Course Objectives:

The main objectives of this course are to:

1. Suffice the students to have an overall exposure to the elements of stochastic processes so as to gain a complete knowledge of stochastic processes.
2. Create analytical skills and practical thinking to apply the gained knowledge in real life situation.
3. Sharpen the knowledge of students towards generalizing the existing results for advanced technological applications.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Know the basic knowledge about stochastic processes.	K1
2	Acquire more detailed knowledge about Markov process with discrete and continuous state space.	K1, K3
3	Understand the different aspects of queueing systems and their significance.	K2
4	Take into consideration the impact of Brownian motion in models involving random phenomena.	K4, K5
5	Master the generalized Markov models and evaluate the pros and cons.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Continuous-Time Markov Models**	**14 hours**

Continuous time Markov chain – Examples – Transient analysis – Occupancy times – Limiting behaviour.

Unit:2	**Generalized Markov Models**	**15 hours**

Renewal process – Cumulative process – Semi-Markov process – Examples and long term analysis.		
Unit:3	**Queueing Models**	**15 hours**
Queueing systems – Single-station queues – Birth and death queues with finite and infinite capacity.		
Unit:4	**Queues and Networks**	**15 hours**
M/G/1 and G/M/1 queues and network of queues.		
Unit:5	**Brownian Motion**	**14 hours**
Standard Brownian motion – Brownian motion and first passage times.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars		
	Total Lecture hours	**75 hours**

Text Book:

1	V.G. Kulkarni, Introduction to Modeling and Analysis of Stochastic Systems, Second Edition, Springer, New York, 2011.

Reference Books:

1	S. M. Ross, Stochastic Processes, Second Edition, Wiley, New York, 1996.
2	J. Medhi, Stochastic Processes, Second Edition, New Age International, New Delhi, 2001.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.edx.org/course/introduction-to-probability
2	https://nptel.ac.in/courses/111/102/111102014/
3	https://nptel.ac.in/courses/115/106/115106089/

Course Designed By: **Dr. M. SUVINTHRA**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	S	S	S	M	S
CO3	S	S	S	S	M	S	S
CO3	S	S	M	S	S	S	S
CO4	S	S	S	M	S	S	S
CO5	S	S	M	S	S	M	S

*S-Strong; M-Medium; L-Low

SUPPORTIVE COURSES

SUPPORTIVE COURSES FOR OTHER DEPARTMENT STUDENTS

Course code	251GS01	NUMERICAL METHODS	L	T	P	C
Core/Elective/Supportive		Supportive	2	-	-	2
Pre-requisite		Fundamentals of calculus, linear algebra and differential equations.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Solve complex mathematical problems using only simple arithmetic operations. The approach involves formulation of mathematical models of physical situations that can be solved with arithmetic operations.

2. Deal with various topics like finding roots of equations, solving systems of linear algebraic equations, interpolation and regression analysis, numerical integration & differentiation, solution of differential equation, boundary value problems, solution of matrix problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Apply numerical methods to obtain approximate solutions to mathematical problems.	K1, K3
2	Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.	K2
3	Use numerical methods to find our solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations.	K1
4	Work numerically on the ordinary differential equations using different methods through the theory of finite differences.	K4
5	Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations, improve and implement stable and accurate numerical methods to solve linear systems of equations and find roots of linear and non-linear equations.	K5, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Solution of Numerical Algebraic and Transcendental Equations	7 hours

The bisection method – Method of successive approximations – Regula–Falsi Method.

Unit:2	Solution of Numerical Algebraic and Transcendental Equations	7 hours

Newton’s Raphson method – Convergence of Newton’s method and rate of convergence.

Unit:3	Solution of Simultaneous Linear Algebraic Equations	7 hours
Gauss elimination method – Gauss Jordan method – Jacobi iterative method – Gauss Seidal method – Comparison of Gauss elimination and Gauss Seidal iteration methods.		
Unit:4	**Numerical Solution of Ordinary Differential Equations**	**7 hours**
Introduction – Power series approximations – Pointwise methods – Solution by Taylor series – Taylor series method for simultaneous first order differential equations.		
Unit:5	**Numerical Integration**	**7 Hours**
Introduction – Trapezoidal rule – Simpson's one-third rule – Simpson's three-eighth rule.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**37 hours**

Text Books:

1	P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company Ltd., New Delhi, 2006.

Reference Books:

1	M.K. Venkataraman, Numerical Methods in Science and Engineering, Fifth Edition, The National Publishing Company, Chennai, 1999.
2	S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, New Delhi, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.mooc-list.com/tags/numerical-methods
2	https://swayam.gov.in/nd1_noc20_ge20/preview
3	https://nptel.ac.in/courses/122/106/122106033/

Course Designed By: **Dr. N. SAKTHIVEL**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Course code	252G144	OPERATIONS RESEARCH	L	T	P	C
Core/Elective/Supportive		Supportive	1	1	-	2
Pre-requisite		Foundation in calculus and linear algebra.	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are to:

1. Suitably frame Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Linear Programming problems.

2. Appropriately formulate Integer Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these IP problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Frame real-world problems as linear programming model.	K1
2	Solve specialized linear programming problems like the transportation and assignment problems.	K5
3	Understand the basic concepts of different advanced models of operations research and their applications.	K2
4	Apply the knowledge of game theory concepts to articulate real-world decision situations for identifying, analyzing, and practicing strategic decisions to counter the consequences.	K4
5	Use of Operations Research approaches and computer tools in solving real problems in industry, Design new simple models, like: CPM, PERT to improve decision–making and develop critical thinking and objective analysis of decision problems.	K3, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Linear Programming Problem	7 hours

Mathematical formulation – Illustrations on mathematical formulation on linear programming problems – Canonical and standard forms of linear programming problem.

Unit:2	Transportation Problem	7 hours

LP formulation of the TP – Solution of a TP – Finding an initial basic feasible solution (NWCM - LCM - VAM).

Unit:3	Assignment Problem	7 hours

Solution methods of assignment problem – Special cases in assignment problem.

Unit:4	Games and Strategies	7 hours

Some basic terms-the maximin-minimax principle - Games without saddle points.

Unit:5	PERT and CPM	7 hours

Basic components – Logical sequencing – Rules of network construction – Critical path analysis.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – Webinars.		
	Total Lecture hours	**37 hours**

Text Books:

1	Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Thirteenth Edition, Sultan Chand and Sons, New Delhi, 2007.
2	V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan, Resource Management Techniques, A.R. Publications, Chennai, 2002.

Reference Books:

1	H.A. Taha, Operations Research: An Introduction, Eighth Edition, Pearson Prentice Hall, New Jersey, 2007.
2	P.K. Gupta and D.S. Hira, Operations Research, Seventh Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2014.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayam.gov.in/nd1_noc19_ma29/preview
2	https://swayam.gov.in/nd1_noc20_ma32
3	https://nptel.ac.in/content/storage2/courses/105108127/pdf/Module_1/M1L1slides.pdf

Course Designed By: **Dr. P. JAYARAMAN**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	S	S	M	S	S	M	M
CO2	M	M	S	S	S	S	S
CO3	S	S	S	S	M	M	S
CO4	S	S	M	S	M	S	S
CO5	M	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

SELF LEARNING COURSE

Course code		HEALTH & WELLNESS	L	T	P	C
		Self-Learning Course	-	-	1	1
Pre-requisite		Basic understanding about wellbeing	Syllabus Version		2025-2026	

Course Objectives:

The main objectives of this course are:

- The Health & Wellness course focuses on teaching the elements of physical, mental, emotional, social, intellectual, environmental well-being which are essential for overall development of an individual.
- The course also addresses the dangers of substance abuse and online risks to promote emotional and mental health.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Demonstrate proficiency in sports training and physical fitness practices.	K3
2	Improve their mental and emotional well-being, fostering a positive outlook on health and life.	K1, K2
3	Develop competence and commitment as professionals in the field of health and wellness.	K6
4	Awareness on drug addiction and its ill effects	K4, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Introduction to Holistic Well-being	1 hour

Introduce the core components of Health & Well-being namely Physical, mental and emotional well-being- Provide worksheets on all the four components individually and explain the interconnectedness to give an overall understanding.

Unit:2	Wellness Wheel Exercise (Overall Analysis)	1 hour

Guide students to assess their well-being in various life dimensions through exercises on various aspects of well-being, and explain the benefits of applying wellness wheel-Introduce Tech Tools: Explore the use of technology to support well-being - Introduce students to apps for meditation, sleep tracking, or healthy recipe inspiration.

Unit:3	Breaking Bad Habits (Overall Analysis)	1 hour

Open a discussion on bad habits and their harmful effects-Provide a worksheet to the students to identify their personal bad habits-Discuss the trigger, cause, consequence and solution with examples-Guide them to replace the bad habits with good ones through worksheets.

Unit:4	Physical Well-Being	2 hours

Fitness: Introduce the different types of fitness activities such as basic exercises, cardiovascular exercises, strength training exercises, flexibility exercises, so on and so forth.
Nutrition: Facilitate students to reflect on their eating habits, their body type, and to test their knowledge on nutrition, its sources and the benefits.
Yoga & Meditation: Discuss the benefits of -Yoga and Meditation for one's overall health
Brain Health: Discuss the importance of brain health for daily life-Habits that affect brain health (irregular sleep, eating, screen time). Habits that help for healthy brains (reading, proper sleep, exercises).
Benefits of breathing exercises and meditation for healthy lungs.
Healthy lungs: Discuss the importance of lung health for daily life-Habits that affect lung health (smoking, lack of exercises)-Benefits of breathing exercises for healthy lungs.
Hygiene and Grooming: Discuss the importance of hygienic habits for good oral, vision, hearing and skin health- Discuss the positive effects of grooming on one's confidence level and professional growth.

Unit:5	**Emotional Well-being**	**2 hours**

Stress Management: Trigger a conversation or provide self-reflective worksheets to identify the stress factors in daily life and their impact on students' performance-Introduce different relaxation techniques like deep breathing, progressive muscle relaxation, or guided imagery.
Importance of saying 'NO': Explain the students that saying 'NO' is important for their Physical and mental well-being, Academic Performance, Growth and Future, Confidence, Self-respect, Strong and Healthy Relationships, building reputation for self and their family (avoid earning a bad name)-Factors that prevent them from saying 'NO'. How to practice saying 'NO".
Body Positivity and self-acceptance –Why is it important?,, Be kind to yourself- Understand that everyone's unique

Unit:6	**Social Well-Being: Practicing Gratitude**	**2 hours**

Cultivating Kindness and Compassion: Define and differentiate between kindness and compassion. Explore practices that cultivate these positive emotions.
Self-Compassion as the Foundation.-The power of small gestures. Understanding another's perspective. The fruits of compassion.
Practicing Forgiveness: Discuss the concept of forgiveness and its benefits. Forgiveness: What is it? And What it isn't?-Benefits of forgiveness. Finding forgiveness practices.
Celebrating Differences: Appreciate the value of individual differences and foster inclusivity. The World: A Tapestry of Differences (cultures, backgrounds, beliefs, abilities, and appearances)-Finding strength in differences (diverse perspectives and experiences lead to better problem-solving and innovation)-Celebrating differences, not ignoring them (respecting and appreciating the unique qualities)
Digital Detox- Introduce the students to: The concept of a digital detox and its benefits for social well-being. How to disconnect from devices more often to strengthen real- world connections.

Unit:7	**Intellectual Well-being**	**2 hours**

Being a lifelong Learner: Give students an understanding on: The relevance of intellectual well-being in this 21st century to meet the expectations in personal and professional well-being- The

Importance of enhancing problem-solving skills- Cultivating habits to enhance the intellectual well-being (using the library extensively, participating in extra-curricular activities, reading newspaper etc.)

Digital Literacy Discuss: The key aspects of digital literacy and its importance in today's World-It is more than just liking and sharing on social media-The four major components of digital literacy (critical thinking, communication, problem-solving, digital citizenship). Why is digital literacy important? Boosting one's digital skills.

Transfer of Learning: Connections between different subjects — How knowledge gained in one area can be applied to others.

Unit:8	**Environmental Well-being**	**1 hour**

The Importance of initiating a change in the environment. The session could be around: Defining Environmental well-being (physical, chemical, biological, social, and psychosocial factors) – People's behavior, crime, pollution, political activities, infra-structure, family situation etc. Suggesting different ways of initiating changes in the environment (taking responsibility, creating awareness, volunteering, approaching administration.

Unit: 9	**Mental Wellbeing**	**2 hours**

Importance of self-reflection: Steps involved in achieving mental wellbeing (self-reflection, self-awareness, applying actions, achieving mental wellbeing)-Difference ways to achieve mental well-being (finding purpose, coping with stress, moral compass, connecting for a common cause). The role of journalizing in mental wellbeing.

Mindfulness and Meditation Practices: Benefits of practicing mindful habits and meditation for overall well-being-Connecting with nature: Practicing to be in the present moment – Nature walk, feeling the sun, listening to the natural sound – Exploring with intention – Hiking, gardening to observe the nature. Reflecting on the emotions, and feeling kindled by nature-Serving people Identifying the needs of others. Helping other: Volunteering your time, skills and listening ear-Finding joy in giving

Creative Expressions: Indulging in writing poems, stories, music making/listening, creating visual arts to connect with inner selves.

Unit: 10	**Situational Awareness (Developing Life skills)**	**1 hour**

Being street smart: Who are street smart? Why is it important to be street smart? Characteristics of a street smart person: Importance of acquiring life skills to become street smart — (General First-aid procedure, CPR Procedure, Handling emergency situations like fire, flood etc.)-Digital Awareness Discuss: Cyber Security Information Literacy Digital Privacy Fraud Detection

Unit: 11	**Understanding Addiction Plan**	**1 hour**

Identifying the environmental cues, triggers that lead to picking up this habit. Knowing the impact of substance abuse — Adverse health conditions, social isolation, ruined future, hidden financial loss and damaging the family reputation-Seeking help to get out of this addiction.

	Total Lecture Hours	**16 hours**

Related Online Contents:

1.	https://www.un.org/sustainabledevelopment/health/
2.	https://healthlibrary.stanford.edu/books-resources/mindfulness-meditation.html

3.	https://jamesclear.com/habits
4.	https://www.lorman.com/blog/post/how-to-keep-your-brain-sharp
5.	https://positivepsychology.com/social-wellbeing/
6.	https://www.verywellmind.com/how-your-environment-affects-your-mental-health-5093687
7.	https://www.betterup.com/blog/how-to-say-no

JOB ORIENTED COURSES

JOB ORIENTED CERTIFICATE COURSE-I

TITLE OF THE JOB ORIENTED CERTIFICATE COURSE	Latex
Name of the Department	Applied Mathematics
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	**Dr. N. SAKTHIVEL** Assistant Professor Department of Applied Mathematics Bharathiar University, Coimbatore-641046 Ph: +91 90800 74484 e-mail ID: nsakthivel1981@gmail.com
Inter / Intra Department Course	Intra Department
Duration of the Course	30 hours
Eligibility	B.Sc. Mathematics/B.Sc. Mathematics (CA) or equivalent degree
Number of Candidates to be Admitted	40
Mode of the Course	Both Regular and Online
Collaboration if any with Companies (if Yes, Full Address of the Company Address , Name of the Contact Person, Phone, e-mail etc.)	Nil
Registration Procedure	Online /offline application advertised via Bharathiar University Website

Job Opportunities:

On successful completion of the course, the students will be able to

1. Have job opportunities on professional typesetting, latex paginator, template developer and etc.
2. Take up profession in document preparation in scientific publishing companies and journal magazine, etc.

The objectives of the Course are:

The main objectives of this course are to make the candidates to

1	Format words, lines and paragraphs, design pages, create lists, tables, references and figures in LATEX.
2	To handle more complicated parts of typesetting such as inputting mathematical symbols, creating table of contents, referencing and creating bibliography.
3	Prepare oral presentations and poster designed using the beamer and poster class file in latex.

Course Content	Lecture / Practical / Project / Internship	
Module 1	Introduction	**2- hours**

Module 2	Command names and arguments – Environments – Declarations.	**3- hours**
Module 3	Special Characters – Document layout and organization.	**3- hours**
Module 4	Document class – Page style – Parts of the document.	**3-hours**
Module 5	Displayed text: Changing font – Centering and indenting.	**2- hours**
Module 6	Theorem-like declarations – Boxes – Tables – Footnotes and marginal notes.	**3- hours**
Module 7	Practicals	**2- hours**
Module 8	Mathematical Formulas: Main elements of math mode – Mathematical symbols – Additional elements.	**3- hours**
Module 9	Practicals	**2- hours**
Module 10	Fine-tuning mathematics – Drawing pictures with LATEX. Mathematical functions.	**3- hours**
Module 11	Practicals	**2- hours**
Module 12	Graphics	**2- hours**
	Total	**30-hours**

Book for Study:

1	H. Kopka and P. W. Daly, A Guide to LATEX, Third Edition, Addison Wesley, London, 1999.

Books for reference:

1	G. Gratzer, Math into LATEX, Birkhauser, Boston, 2000.
2	L. Lamport, LATEX, A Document Preparation System, Addison-Wesley, California, 1994.

Related Online Contents:

1	https://swayam.gov.in/nd2_aic20_sp17/
2	https://www.mooc-list.com/tags/latex
3	https://www.classcentral.com/course/edx-latex-for-students-engineers-and-scientists-15

JOB ORIENTED CERTIFICATE COURSE-II

MATHEMATICAL SKILL DEVELOPMENT	
Name of the Department	Department of Applied Mathematics
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	**Dr. N. Nithyadevi** Assistant Professor Department of Applied Mathematics Bharathiar University Coimbatore – 641 046 Ph: +91 90036 59393 e-mail ID: nithyadevin@gmail.com
Inter / Intra Department Course	Intra Department
Duration of the Course	30 hours
Eligibility	B.Sc. Mathematics/B.Sc. Mathematics (CA) or equivalent degree
Number of Candidates to be Admitted	40
Registration Procedure	Online mode/Offline mode via Bharathiar University Portal

Job Opportunities:

The candidates would be enriched with deeper understanding of mathematical concepts and problem solving skills, which aid them to succeed in competitive examinations and also to get through tests like GATE, CSIR-NET and SET which in turn open up lots of job opportunities and positions in higher education sectors.

The objectives of the Course are:

The main objectives of this course are to:

1	Improve the logical thinking skills of the candidates.
2	Teach few short-cut techniques to solve problems from algebra.
3	Provoke the visualizing capacity of the candidates to understand the analytical concepts.
4	Motivate the candidates to interpret the theoretical concepts clearly and apply the learned concepts to solve technical problems.
5	Enrich with problem solving skills so as to use mathematical tools to tackle real problems from scientific/engineering/industrial sectors.

Course Content	Lecture / Practical / Project / Internship

Module 1	General Aptitude	**3-- hours**
Module 2	Linear Algebra	**3-- hours**
Module 3	Algebra	**3-- hours**
Module 4	Real Analysis	**3-- hours**
Module 5	Complex Analysis	**3-- hours**
Module 6	Topology & Functional Analysis	**3-- hours**
Module 7	Differential & Integral Equations	**3-- hours**
Module 8	Calculus of Variations & Mechanics	**3-- hours**

Module 9	Numerical Analysis	**3-- hours**
Module 10	Statistics & Probability Theory	**3-- hours**
		30 hours

Books for Study:	
1	R. S. Aggarwal, Quantitative Aptitude, Sultan Chand and Company, New Delhi, 2017.
2	K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall, New Jersey, 1971.
3	J. A. Gallian, Contemporary Abstract Algebra, Cengage Learning, Boston, 2016.
4	R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, Wiley, New York, 2011.
5	P. Duraipandian, L. Duraipandian and D. Muhilan, Complex Analysis, Emerald Publishers, Chennai, 2008.
6	S. Lipschutz, Schaum's Outline of Theory and Problems of General Topology, McGraw-Hill Book Company, New York, 1965.
7	S. Kesavan, Functional Analysis, Hindustan Book Agency, New Delhi, 2009.
8	M.D. Raisinghania, Ordinary and Partial Differential Equations, Sultan Chand and Company, New Delhi, 2013.
9	L. Elsgolts, Differential Equations and the Calculus of Variations, MIR Publishers, Moscow, 1970.
10	H. Goldstein, C. Poole and J. Safko, Classical Mechanics, Pearson Education, New Delhi, 2002.
11	P. Kandasamy, K. Thilagavathy and K. Gunavathi, Numerical Methods, S. Chand and Company, New Delhi, 2003.
12	S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand and Sons, New Delhi, 2003.
13	W. Feller, An Introduction to Probability Theory and its Applications, Wiley, New Delhi, 2012.
Books for reference:	
1	D.C. Lay, Linear Algebra and its Applications, Addison-Wesley, New York, 1998.
2	S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, New Delhi, 2012.
Related Online Contents:	
1	https://ocw.mit.edu/courses/mathematics/18-330-introduction-to-numerical-analysis-spring-2012/lecture-notes/
2	https://www.probabilitycourse.com/

VALUE ADDED COURSES

VALUE ADDED COURSE-I

INTRODUCTION TO MACHINE LEARNING	
Name of the Department	Department of Applied Mathematics
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	**Dr. N. Nithyadevi** Assistant Professor Department of Applied Mathematics Bharathiar University Coimbatore – 641 046 Ph: +91 90036 59393 e-mail ID: nithyadevin@gmail.com
Inter / Intra Department Course	Inter-Department
Duration of the Course	3 months
Eligibility	A UG degree with Mathematics as Major/Allied Subject
Number of Candidates to be Admitted	30
Registration Procedure	Online mode/Offline mode via Bharathiar University Portal

Job Opportunities:

1. Design suitable ML solutions to solve real-world problems in the AI domain.
2. Understanding how ML algorithms work and improve them with the theoretical foundations of mathematics.

The objectives of the Course are:

The main objectives of this course are to:

1	Get explored to the basic concepts of machine learning.
2	Impart knowledge on the types of machine learning.
3	Get equipped with the idea of decision tree representation and learn the basic decision tree algorithm.
4	Understand the fundamentals of artificial neural networks.
5	Learn the back propagation algorithm and apply for face recognition.

Course Content	Lecture / Practical / Project / Internship

Module 1	Introduction – Types of machine learning: Supervised, unsupervised, semi-supervised learning.	**4-- hours**
Module 2	Well-posed learning problems – Designing a learning system.	**4-- hours**
Module 3	Concept learning – Concept learning as search.	**4-- hours**
Module 4	Finding a maximally specific hypothesis – Inductive bias.	**4-- hours**
Module 5	Decision tree representation – Appropriate problems for decision tree learning.	**4-- hours**
Module 6	The basic decision tree algorithm.	**4-- hours**
Module 7	Artificial neural networks – Neural network representations.	**4-- hours**

Module 8	Problems for neural network learning.	**4-- hours**
Module 9	Multilayer networks and the back propagation algorithm.	**4-- hours**
Module 10	An illustrative example: face recognition.	**4-- hours**

Book for Study:

1	Tom M. Mitchell, Machine Learning, McGraw Hill, Portland, 2017.

Books for reference:

1	Ethem Alpaydin, Introduction to Machine Learning, Third Edition, The MIT Press, London, 2014.
2	Stephen Marsland, Machine Learning – An Algorithmic Perspective, Second Edition, CRC Press, New York, 2014.

Related Online Contents:

1	https://www.deeplearning.ai/machine-learning-yearning/
2	https://www.geeksforgeeks.org/machine-learning/

VALUE ADDED COURSE-II

INTRODUCTION TO ARTIFICIAL INTELLIGENCE	
Name of the Department	Department of Applied Mathematics
Name of the Faculty Member i/c With Complete Address with Phone and e-mail	**Dr. N. Sakthivel** Assistant Professor Department of Applied Mathematics Bharathiar University Coimbatore – 641 046 Ph: +91 90800 74484 e-mail ID: nsakthivel1981@gmail.com
Inter / Intra Department Course	Inter-Department
Duration of the Course	3 months
Eligibility	A UG degree with Mathematics as Major/Allied Subject
Number of Candidates to be Admitted	30
Registration Procedure	Online mode/Offline mode via Bharathiar University Portal

Job Opportunities:

1. Developing and implementing AI algorithms and models, often requiring a strong foundation in mathematics, especially linear algebra, calculus, and probability.
2. Data scientists who analyze data to identify patterns and insights.

The objectives of the Course are:		
The main objectives of this course are to:		
1	Get to know an overview of Artificial Intelligence.	
2	Understand the basic principles of Artificial Intelligence including agents, environments and search strategies.	
3	Get explored to the applications of AI in game theory and other disciplines.	
4	Familiarize the concepts of CSP and Knowledge Representation in AI.	
5	Impart the knowledge on propositional and first order logics.	
Course Content	Lecture / Practical / Project / Internship	
Module 1	What is AI?	**4-- hours**
Module 2	Foundations of AI – History of AI.	**4-- hours**
Module 3	Agents and environments – Structure of agents.	**4-- hours**
Module 4	Uninformed search strategies.	**4-- hours**
Module 5	Informed (heuristic) search strategies.	**4-- hours**
Module 6	Local search algorithms and optimization problems.	**4-- hours**
Module 7	Games – Optimal decision in games.	**4-- hours**
Module 8	Alpha-beta pruning.	**4-- hours**
Module 9	Constraint satisfaction problems – Knowledge representation.	**4-- hours**
Module 10	Logic – propositional logic – First order logic.	**4-- hours**
Books for Study:		
1	S. J. Russell and P. Norvig, Artificial Intelligence – A Modern Approach, Third Edition, Prentice Hall, San Francisco, 2020.	
Books for reference:		
1	Elaine Rich, Kevin Knight and S.B. Nair, Artificial Intelligence (SIE), McGraw Hill, New Delhi, 2008.	
2	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, New Delhi, 2002.	
Related Online Contents:		
1	https://www.tutorialspoint.com/artificial_intelligence/index.htm	
2	https://www.udacity.com/course/intro-to-artificial-intelligence--cs271	