**M. Sc. Mathematics with Computer Applications**

**Syllabus**

**(with effect from 2024-2025 onwards)**

**Program Code: AMAA**



**DEPARTMENT OF APPLIED MATHEMATICS**

**Bharathiar University**

**(A State University, Accredited with “A++ ” Grade by NAAC and**

**21st Rank among Indian Universities by MoE-NIRF)**

**Coimbatore 641 046, INDIA**

**BHARATHIAR UNIVERSITY : : COIMBATORE 641046**

**DEPARTMENT OF APPLIED MATHEMATICS**

**MISSION**

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

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| **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 keeps 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 aware of the graduates on public concern and to instill moral and ethical behaviors to shape them as a well human beings |

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| **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 adopt to use professional information and technological tools to support communication and develop the study of Mathematics |

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| **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 updating 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 design of experiments, 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 |
| PO8 | pertain ethical values with high professionalism and responsibilities  into the domain. |
| PO9 | perform efficiently as an individual and in part of assorted teams in multidisciplinary environments. |
| PO10 | adapt to the changing mathematical and scientific computational techniques |

**BHARATHIAR UNIVERSITY: : COIMBATORE 641 046**

**M. Sc. Mathematics with Computer Applications**

**Curriculum (University Department)**

*(For the students admitted during the academic year 2024 – 25 onwards)*

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| **Course Code** | **Title of the Course** | **Credits** | **Hours** | | **Maximum Marks** | | |
| **Theory** | **Practical** | **CIA** | **CEE** | **Total** |
| **FIRST SEMESTER** | | | | | | | |
| 21AMAA13A | Abstract Algebra | 4 | 5 | - | 25 | 75 | 100 |
| 22AMAA13B | Real Analysis | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA13C | Ordinary Differential Equations | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA13D | Programming in C++ | 2 | 2 | - | 12 | 38 | 50 |
| 21AMAA13P | Practical I : Programming in C++ | 2 | - | 4 | 12 | 38 | 50 |
| 22AMAA1EA/21AMAA1EB | Numerical Analysis/ Mathematical Statistics | 4 | 5 | - | 25 | 75 | 100 |
| Supportive | Offered by other Departments | 2 | 2 | - | 12 | 38 | 50 |
|  | **Total** | 22 | 24 | 4 | 136 | 414 | 550 |
| **SECOND SEMESTER** | | | | | | | |
| 21AMAA23A | Complex Analysis | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA23B | Partial Differential Equations | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA23C | Mechanics | 4 | 5 | - | 25 | 75 | 100 |
| 22AMAA23D | Java Programming | 2 | 2 | - | 12 | 38 | 50 |
| 22AMAA23P | Practical II : Java Programming | 2 | - | 4 | 12 | 38 | 50 |
| 21AMAA2EC/ 21AMAA2ED | Linear Algebra / Graph Theory | 4 | 5 | - | 25 | 75 | 100 |
| Supportive | Offered by other Departments | 2 | 2 | - | 12 | 38 | 50 |
|  | **Total** | 22 | 24 | 4 | 136 | 414 | 550 |
| **THIRD SEMESTER** | | | | | | | |
| 22AMAA33A | Topology | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA33B | Fluid Dynamics | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA33C | Mathematical Methods | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA33A | Matlab | 2 | 2 | - | 12 | 38 | 50 |
| 21AMAA33P | Practical III :Matlab | 2 | - | 4 | 12 | 38 | 50 |
| 21AMAA3EE/  21AMAA3EF | Fuzzy Set Theory / Discrete Mathematics | 4 | 5 | - | 25 | 75 | 100 |
| Supportive | Offered by other Departments | 2 | 2 | - | 12 | 38 | 50 |
|  | **Total** | 22 | 24 | 4 | 136 | 414 | 550 |
| **FOURTH SEMESTER** | | | | | | | |
| 21AMAA43A | Functional Analysis | 4 | 5 | - | 25 | 75 | 100 |
| 22AMAA43B | Optimization Techniques | 4 | 5 | - | 25 | 75 | 100 |
| 21AMAA43C | Python Programming | 2 | 2 | - | 12 | 38 | 50 |
| 21AMAA43P | Practical IV : Python Programming | 2 | - | 4 | 12 | 38 | 50 |
| 21AMAA4EG  /21AMAA4EH | Control Theory/ Elements of Stochastic Processes | 4 | 4 | - | 25 | 75 | 100 |
| 21AMAA47V | Project / Dissertation + Viva-voce | 8 | 8 | - | 100 | 100 | 200 |
| **Total** | | 24 | 24 | 4 | 199 | 401 | 600 |
| **Grand Total** | | 90 | 96 | 16 | 607 | 1643 | 2250 |
| **ONLINE COURSES** | | | | | | | |
|  | SWAYAM – MOOC – Online Course\* | 2 | - | - | - | - | - |
| **VALUE ADDED COURSES** | | | | | | | |
|  | **Value Added Course- I** | 2 | - | - | - | - | 50 |
|  | **Value Added Course-II** | 2 | - | - | - | - | 50 |
| **JOB ORIENTED COURSES** | | | | | | | |
|  | **Job Oriented Certificate Course-I** | 2 | - | - | - | - | 50 |
|  | **Job Oriented Certificate Course-II** | 2 | - | - | - | - | 50 |

\*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).

**SUPPORTIVE COURSES FOR OTHER DEPARTMENT STUDENTS**

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| **Course Code** | **Title of the Course** | **Credits** | **Hours** | | **Maximum Marks** | | |
| **Theory** | **Practical** | **CIA** | **CEE** | **Total** |
| **FIRST /THIRD SEMESTER** | | | | | | | |
| 21GS01 | Numerical Methods | 2 | 2 | - | 12 | 38 | 50 |
| **SECOND SEMESTER** | | | | | | | |
| 21G144 | Operations Research | 2 | 2 | - | 12 | 38 | 50 |

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| **Course code** | | | | **21AMAA13A** | **ABSTRACT ALGEBRA** | **L** | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **3** | | **1** | **-** | **4** |
| **Pre-requisite** | | | | | Group Theory | **Syllabus Version** | | | **2021-2022** | |
| **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. 3. communicate several theorems in both applied and theoretical points of view. | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | |
| 1 | | | distinguish and use the Sylow Theorems to characterize certain finite groups | | | | | | K1 | |
| 2 | | | understand and demonstrate competence with the basic ideas of algebra including the concepts of direct products, splitting fields, Galois group and solvable group | | | | | | K2 | |
| 3 | | | demonstrate knowledge of the structures of fields, extension fields and finite fields | | | | | | K3 | |
| 4 | | | analyze and appreciate the significance of Sylow’s theorem and Galois theory also able to construct mathematical proof for various theorems | | | | | | K4  K5 | |
| 5 | | | analyze the solvability of polynomials by radicals | | | | | | K4 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | |
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| **Unit:1** | | | | **Sylow’s Theorem** | | | **13 hours** | | | |
| Counting Principle – Three parts of Sylow’s Theorems – double coset – the normalizer of a group | | | | | | | | | | |
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| **Unit:2** | | | | **Finite Abelian Groups** | | | **11 hours** | | | |
| External and Internal direct Products – structure theorem for finite abelian groups – non iso-morphic abelian groups - polynomial rings | | | | | | | | | | |
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| **Unit:3** | | | | **Splitting Field** | | | **12 hours** | | | |
| Polynomials over rational fields – the Eisenstein criterion - extension fields – roots of polynomials – splitting fields | | | | | | | | | | |
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| **Unit:4** | | | | **Galois Theory** | | | **12 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** | | | **12 hours** | | | |
| Solvable group – the commutator subgroup – Solvability by radicals - finite fields. | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | **2 hours** | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | |
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|  | | | | **Total Lecture hours** | | | **62 hours** | | | |
| **Text Book(s)** | | | | | | | | | | |
| 1 | I.N. Herstein, Topics in Algebra*,* Second Edition, John Wiley and Sons, New York, 2000. | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | |
| 1 | J. B. Fraleigh, A First Course in Abstract Algebra*,* Seventh Edition, Pearson Education, New York, 2005. | | | | | | | | | |
| 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 | J. A. Gallian, Contemporary Abstract Algebra, Eight Edition, Brooks/Cole Cengage Learning, Lexington, 2013. | | | | | | | | | |
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| **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> | | | | | | | | |
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| Course Designed By: Dr.P.DHANALAKSHMI | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | L | L | M | L | M | S |
| **CO2** | S | M | S | S | L | S | M | S | L | M |
| **CO3** | S | S | S | S | L | S | S | M | M | S |
| **CO4** | S | S | M | M | M | S | S | S | L | S |
| **CO5** | S | S | L | S | M | S | S | S | M | M |

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

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| **Course code** | | | | | **22AMAA13B** | | | | **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** | | | | | | **2022-2023** | | |
| **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 . 2. includes 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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | determine the Riemann-Stieltjes integrability of a bonded 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 | | | | | | | | | | | | | | | | | | | K6 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | | **Contemporary Issues** | | | | | | | | | | | **2 hours** | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | **Total Lecture hours** | | | | | | | | | | | **75 hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | | | | | | | | | |
| 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. | | | | | | | | | | | | | | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Tom M. Apostol, Mathematical Analysis, Narosa Publishing House, New Delhi, 1997. | | | | | | | | | | | | | | | | | | | | | | |
| 2 | S. Kumaresan, Topology of Metric Spaces, Second Edition, Narosa Publishing House, 2011. | | | | | | | | | | | | | | | | | | | | | | |
| 3 | S. Ponnusamy, Foundations of Mathematical Analysis, Springer Birkhauser, 2012. | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Inder K. Rana, An Introduction to Measure and Integration, Second Edition,Narosa Publishing House, 2015. | | | | | | | | | | | | | | | | | | | | | | |
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| **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/> | | | | | | | | | | | | | | | | | | | | | |
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| Course Designed By: Dr.N.SAKTHIVEL | | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | | | | **PO1** | | | **PO2** | **PO3** | | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | | **PO9** | | | | **PO10** | | | |
| **CO1** | | | | **S** | | | **S** | **M** | | **S** | **S** | **M** | **M** | **M** | | **S** | | | | **S** | | | |
| **CO2** | | | | **M** | | | **M** | **S** | | **S** | **S** | **S** | **S** | **L** | | **M** | | | | **M** | | | |
| **CO3** | | | | **S** | | | **S** | **S** | | **S** | **M** | **L** | **S** | **S** | | **L** | | | | **L** | | | |
| **CO4** | | | | **S** | | | **S** | **L** | | **S** | **M** | **S** | **S** | **M** | | **M** | | | | **M** | | | |
| **CO5** | | | | **M** | | | **M** | **S** | | **S** | **S** | **S** | **M** | **L** | | **M** | | | | **S** | | | |

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

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| **Course**  **code** | | | | **21AMAA13C** | **ORDINARY DIFFERENTIAL EQUATIONS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **3** | **1** | **-** | **4** |
| **Pre-requisite** | | | | | Basics of calculus including differentiation, integration, series, and methods of approximation. | **Syllabus**  **Version** | | **2021-2022** | |
| **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. | | | | | | | | | |
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| **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 | | | obtain solutions of the homogeneous and non-homogeneous equations with constant co-efficients. | | | | | K5 | |
| 3 | | | find particular solutions to initial value problems. | | | | | K6 | |
| 4 | | | recognize and solve a linear differential equation by use of an integrating factor. | | | | | K4 | |
| 5 | | | identify and solve a variable separable differential equations | | | | | K3 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | |
|  | | | | | | | | | |
| **Unit:1** | | | | **Linear Equations with Constant Coefficients** | | | **12 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’** | | | **12 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** | | | **12 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** | | | **12 hours** | | |
| Euler equation - Second order equations with regular singular points – Exceptional cases – Bessel equation. | | | | | | | | | |
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| **Unit:5** | | | | **Existence and Uniqueness of Solutions to First Order Equations** | | | **12 hours** | | |
| Equation with variables separated – Exact equations – The method of successive approximations – The Lipchitz condition – Convergence of the successive approximations. | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | **2 hours** | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | |
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|  | | | | **Total Lecture hours** | | **62 hours** | | | |
| **Text Book** | | | | | | | | | |
| 1 | E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall of India Ltd., New Delhi, 2004. | | | | | | | | |
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| **Reference Books** | | | | | | | | | |
| 1 | W. E. Boyce and R.C. Di-Prima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons, New York, 2001. | | | | | | | | |
| 2 | G. F. Simmons, Differential Equations with Applications and Historical Notes, Third Edition, CRC press, Boca Raton, 2017. | | | | | | | | |
| 3 | P. J. Collins, Differential and Integral Equations, Oxford University Press, New York, 2006. | | | | | | | | |
| 4 | M. D. Raisinghania, Advanced Differential Equations, S. Chand & Company Ltd., New Delhi, 2012. | | | | | | | | |
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| **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/> | | | | | | | |
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| Course Designed By: Dr. R. SAKTHIVEL | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | L | M | S |
| **CO2** | M | M | S | S | S | S | S | M | L | M |
| **CO3** | S | S | S | S | L | M | S | S | S | S |
| **CO4** | S | S | L | S | M | S | S | M | M | L |
| **CO5** | M | M | S | S | S | S | M | M | S | M |

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

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| **Course code** | | | | **21AMAA13D** | **PROGRAMMING IN C++** | **L** | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **2** | | | | **-** | | **-** | **2** |
| **Pre-requisite** | | | | | Basic computer knowledge | **Syllabus Version** | | | | | **2021-2022** | | |
| **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. | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | | |
| 1 | | | know 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 | | | | | | | | | K4 | |
| 4 | | | use the concepts of objects, operator overloading and inheritance while programming in C++ | | | | | | | | | K2 | |
| 5 | | | create classes and inherit them in defining new derived classes | | | | | | | | | K6 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | |
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| **Unit:1** | | | | **Principles of Object-Oriented Programming** | | | | **4 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. | | | | | | | | | | | | | |
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| **Unit:2** | | | | **Tokens, Expressions and Control Structures** | | | **4 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. | | | | | | | | | | | | | |
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| **Unit:3** | | | | **Functions in C++ and Managing Console I/O Operations** | | | | | **4 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. | | | | | | | | | | | | | |
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| **Unit:4** | | | | **Classes and Objects** | | | | | **4 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. | | | | | | | | | | | | | |
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| **Unit:5** | | | | **Operator Overloading, Type Conversions and Inheritance** | | | | | **4 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. | | | | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | | | **2 hours** | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | | | **22 hours** | | | | |
| **Text Book(s)** | | | | | | | | | | | | | |
| 1 | E. Balagurusamy, Object Oriented Programming with C++, Tata McGraw-Hill, New Delhi, 2008. | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | |
| 1 | H. Schildt, C++ – The Complete Reference, Tata McGraw-Hill, New Delhi, 1998. | | | | | | | | | | | | |
| 2 | B. Stroustrup,The C++ Programming Language, Addison Wesley, Canada, 1999. | | | | | | | | | | | | |
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| **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 | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | M | M | M | M | S | M |
| **CO3** | S | S | S | S | S | S | M | S | M | M |
| **CO3** | S | S | M | L | S | M | S | S | L | S |
| **CO4** | S | L | S | S | S | S | S | L | M | S |
| **CO5** | S | S | S | S | S | S | S | M | M | S |

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

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| **Course code** | | | **21AMAA13P** | | **Practical I : PROGRAMMING IN C++** | | **L** | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | | **-** | | **-** | | **4** | **2** |
| **Pre-requisite** | | | | | Basic computer programming knowledge | | **Syllabus Version** | | | **2021-2022** | | |
| **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 | | Make 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 | |
| 4 | | Use objects and classes to write programs in C++ | | | | | | | | | K3 | |
| 5 | | Write programs from the underlying algorithms, and demonstrate the ability to employ good commenting and coding techniques. | | | | | | | | | K3 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | |
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|  | | | | **Course Content** | | | |  | | | | |
| 1. Transpose of a Matrix  2. Obtaining Eigen value and Eigen vector 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** | | **40 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 | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | M | M | M | M | L | M |
| **CO3** | S | S | S | S | S | S | M | S | S | M |
| **CO3** | S | S | L | M | S | M | S | M | M | S |
| **CO4** | S | S | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | S | S | S | L | S | L |

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

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| **Course code** | | | | **22AMAA1EA** | **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** | | **2022-2023** | | |
| **Course Objectives:** | | | | | | | | | | |
| The main objectives of this course are to:   1. describing and 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. | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | |
| 1 | | | the convergence analysis of these techniques and explains different types of errors which gets involved and propagates during numerical computations. | | | | | 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 of numerical methods for solving different types of problems like initial and boundary value problems of ordinary and partial differential equations. | | | | | K4 | | |
| 4 | | | determines that 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 | | | | | | | | | | |
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| **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 Seidal iteration. | | | | | | | | | | |
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| **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. | | | | | | | | | | |
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| **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. | | | | | | | | | | |
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| **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. | | | | | | | | | | |
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| **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, Reading, 1998. | | | | | | | | | |
|  | | | | | | | | | | |
| **Reference Book:** | | | | | | | | | | |
| 1 | M.K. Jain, S.R.K. Iyengar, R.K.Jain, Numerical Methods for Scientific and Engineering Computation, Second Edition, Wiley Eastern Ltd, New Delhi | | | | | | | | | |
| 2 | C.E. Froberg, Introduction to Numerical Analysis, Second Edition, Addison-Wesley Publishing Company, 1972. | | | | | | | | | |
| 3 | S. [Azmy Ackleh](https://www.amazon.com/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Azmy+S.+Ackleh&text=Azmy+S.+Ackleh&sort=relevancerank&search-alias=books) , [Edward James Allen](https://www.amazon.com/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Edward+James+Allen&text=Edward+James+Allen&sort=relevancerank&search-alias=books) , [R. Baker Kearfott](https://www.amazon.com/s/ref=dp_byline_sr_book_3?ie=UTF8&field-author=R.+Baker+Kearfott&text=R.+Baker+Kearfott&sort=relevancerank&search-alias=books) , [Padmanabhan Seshaiyer](https://www.amazon.com/s/ref=dp_byline_sr_book_4?ie=UTF8&field-author=Padmanabhan+Seshaiyer&text=Padmanabhan+Seshaiyer&sort=relevancerank&search-alias=books), Classical and modern Numerical Analysis: Theory, Methods and Practice, CRC Press , Taylor& Francis Group, 2009. | | | | | | | | | |
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| **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> | | | | | | | | |
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| Course Designed By: Dr.N.NITHYADEVI | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | M | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | M | L | S | M | L | S |
| **CO4** | S | S | L | S | M | S | S | M | S | S |
| **CO5** | M | M | S | S | S | S | M | S | S | M |

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

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| **Course code** | | | | **21AMAA1EB** | | **MATHEMATICAL STATISTICS** | **L** | | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Elective** | **3** | | | | | **1** | | **-** | **4** |
| **Pre-requisite** | | | | | | Basic knowledge on statistics at UG level and Integral Calculus | **Syllabus Version** | | | | | | **2021-2022** | | |
| **Course Objectives:** | | | | | | | | | | | | | | | |
| The main objectives of this course are to:  1. introduce the basic concepts of probability, random variables and mathematical expectations.  2. knowledge of probability and the standard statistical distributions.  3. communicate several statistical techniques from both applied and theoretical points of view. | | | | | | | | | | | | | | | |
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| **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 | | | 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 | |
| 4 | | | 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. | | | | | | | | | | | K3 | |
| 5 | | | 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 | |
| **K1** - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | | **Distributions of Random Variables** | | | | | | **12 hours** | | | | |
| The probability set function – Random variables – Probability density function – Distribution function – Mathematical expectation – Special mathematical expectations – Chebyshev’s Inequality. | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | **Conditional Probability And Stochastic Independence** | | | | | **12 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** | | | | **12 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. | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | **Distributions Of Functions Of Random Variables** | | | | **12 hours** | | | | | | |
| The , t and F distributions- Distributions of order statistics- The moment generating function technique. The distributions of X¯ and nS2/ 2 - Expectations of functions of random variables. | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | **Limiting Distributions** | | | **12 hours** | | | | | | | |
| Limiting distributions, Stochastic convergence- Limiting moment generating functions – The Central limit theorem – Some theorems on limiting distributions. | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | **2 hours** | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | |
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|  | | | | | **Total Lecture hours** | | | **62 hours** | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | |
| 1 | R. V. Hogg and A. T. Craig, Introduction to Mathematical Statistics, Fourth Edition, Macmillan Publishing Company, New York, 1978. | | | | | | | | | | | | | | |
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| **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. Dudewiczn and S.N. Mishra, Modern Mathematical Statistics, John Wiley & Sons, New York, 1988. | | | | | | | | | | | | | | |
| 4 | V. N. Rohatgi, An introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Limited, New Delhi, 1988. | | | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | | | |
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| Course Designed By : Dr. N. SAKTHIVEL | | | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | M | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | M | M | S | M | L | S |
| **CO4** | S | S | M | S | L | S | S | M | L | S |
| **CO5** | M | M | S | S | S | S | M | S | S | M |

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

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| **Course code** | | | | **21AMAA23A** | **COMPLEX ANALYSIS** | **L** | **T** | | | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **3** | **1** | | | | **-** | **4** |
| **Pre-requisite** | | | | | Basics of complex numbers - Differentiation and Integration | **Syllabus Version** | | | **2021-2022** | | | |
| **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](https://en.wikipedia.org/wiki/String_theory) which studies conformal invariants in [quantum field theory](https://en.wikipedia.org/wiki/Quantum_field_theory). | | | | | | | | | | | | |
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| **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 of the complex and real integrals using Residue theorem. | | | | | | | K2 | | |
| 3 | | | know that 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. | | | | | | | K5 | | |
| 6 | | | obtain essential concepts of complex integration, Riemann mapping, Elliptic functions. | | | | | | | K6 | | |
| K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create | | | | | | | | | | | | |
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| **Unit:1** | | | | **Complex Integration** | | | | **12 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** | | | | **12 hours** | | | | |
| The Calculus of Residues: Residue theorem - The Argument Principle-Evaluation of Definite Integrals.  Harmonic Functions: Definition of Harmonic function and basic properties - Mean value property - Poisson formula. | | | | | | | | | | | | |
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| **Unit:3** | | | | **Series And Product Developments** | | | **12 hours** | | | | | |
| Power Series Expansions: Weierstrass’s Theorem-The Taylor Series-The Laurent Series.  Partial fractions and entire functions: Partial fractions - Infinite products – Canonical products – Gamma Function- Jensen’s formula – Hadamard’s Theorem.  The Riemann Zeta Function: Product development – Extension of ζ(s) to the whole plane – The zeros of zeta function. | | | | | | | | | | | | |
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| **Unit:4** | | | | **Conformal Mappings** | | | **12 hours** | | | | | |
| Riemann Mapping Theorem**:** Statement and Proof – Boundary Behaviour – Use of the Reflection Principle.  Conformal Mappings of Polygons**:** Behaviour at an angle – Schwarz-Christoffel formula – Mapping on a rectangle.  Harmonic Functions**:** Functions with mean value property – Harnack’s principle. | | | | | | | | | | | | |
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| **Unit:5** | | | | **Elliptic Functions** | | | **12 hours** | | | | | |
| Simply Periodic Functions**:** Representation by Exponentials-The Fourier Development - Functions of Finite Order.  Doubly Periodic Functions**:** The Period Module-Uni modular Transformations-The Canonical Basis-General Properties of Elliptic Functions.  Weierstrass Theory: The Weierstrass-function – The functions (z) and (z) – The differential equation – The modular function () – The Conformal mapping by (). | | | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | **2 hours** | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
|  | | | | Total Lecture hours | | | **62 hours** | | | | | |
| **Text Book(s)** | | | | | | | | | | | | |
| 1 | L. F. Ahlfors, Complex Analysis, Third Edition, McGraw Hill Book Company, New York, 1979. | | | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | | | |
| 1 | J. B. Conway, Functions of One Complex Variable, Springer - Verlag, New York, 1978. | | | | | | | | | | | |
| 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. | | | | | | | | | | | |
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| **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 | | | | | | | | | | |
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| Course Designed By: Dr. N NITHYADEVI | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | L | M |
| **CO3** | M | M | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | L | M | S | M | M | S |
| **CO4** | S | S | M | S | M | S | S | M | S | S |
| **CO5** | M | L | S | S | S | S | M | S | S | L |

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

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| **Course code** | | | | **21AMAA23B** | **PARTIAL DIFFERENTIAL EQUATIONS** | | | | **L** | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | | | | **3** | | **1** | **-** | **4** |
| **Pre-requisite** | | | | | Basics of Differential equations | | | | **Syllabus Version** | | | **2021-2022** | |
| **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 PDEs like applying Separation of Variables to solve elementary problems in linear second order Partial Differential Equations (heat and wave equations) and integral transforms. | | | | | | | | | | | | | |
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| **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 | | | gains 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 PDEs | | | | | | | | | K4 | |
| **K1** - Remember; **K2** - Undestand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | |
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| **Unit:1** | | | | **Partial Differential Equations Of The First Order** | | | | | | **12 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-Special types of first order equations – Solutions satisfying Given Condition, Jacobi’s method.. | | | | | | | | | | | | | |
| **Unit:2** | | | | **Partial Differential Equations Of The SecondOrder** | | | | **12hours** | | | | | |
| 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** | | | **12 hours** | | | | | | |
| Elementary solutions of Laplace equation – Families of Equipotential Surfaces – Boundary value problems – Separation of variables – Surface Boundary Value Problems – Separation of Variables – Problems With Axial Symmetry – The Theory of Green’s Function for Laplace Equation | | | | | | | | | | | | | |
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| **Unit:4** | | | | **The Wave Equation** | | | **12 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. | | | | | | | | | | | | | |
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| **Unit:5** | | | | **The Diffusion Equation** | | **12 hours** | | | | | | | |
| Elementary Solutions of the Diffusion Equation – Separation of variables – The use of Integral Transforms – The use of Green’s functions | | | | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | **2 hours** | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | |
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|  | | | | **Total Lecture hours** | | **62 hours** | | | | | | | |
| **Text Book** | | | | | | | | | | | | | |
| 1 | I. N. Sneddon, Elements of Partial Differential Equations, McGraw Hill International Book Company, New Delhi, 1983. | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
| **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. | | | | | | | | | | | | |
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| **Related Online Contents** | | | | | | | | | | | | | |
| 1 | | <https://www.classcentral.com/course/swayam-partial-differential-equations-17721> | | | | | | | | | | | |
| 2 | | [https://nptel.ac.in/courses/111/103/111103021/#](https://nptel.ac.in/courses/111/103/111103021/) | | | | | | | | | | | |
| 3 | | <https://swayam.gov.in/nd2_cec20_ma08/preview> | | | | | | | | | | | |
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| Course Designed By : Dr.N.SAKTHIVEL | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | M | S | S |
| **CO3** | M | M | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | M | M | S | S | M | L |
| **CO4** | S | S | M | S | L | S | S | M | S | M |
| **CO5** | M | M | S | S | S | S | M | S | L | S |

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

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| **Course code** | | | | **21AMAA23C** | **MECHANICS** | **L** | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **3** | **1** | **-** | **4** |
| **Pre-requisite** | | | | | knowledge about basic Mathematics and Physics | **Syllabus Version** | | **2021-2022** | |
| **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. Make the students learn Lagrangian and Hamiltonian formulations of classical mechanics. 3. impart the importance and consequences of canonical transformations. | | | | | | | | | |
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| **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 | |
| 5 | | | use of analytical treatments in checking the numerical models | | | | | K4 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | |
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| **Unit:1** | | | | **Introductory Concepts** | | | **12 hours** | | |
| The mechanical system – Generalized coordinates – Constraints – Virtual work – Energy and momentum. | | | | | | | | | |
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| **Unit:2** | | | | **Lagrange’s Equations** | | | **12 hours** | | |
| Derivations of Lagrange’s equations- Examples –Integrals of the motion. | | | | | | | | | |
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| **Unit:3** | | | | **Hamilton’s Equations** | | | **12 hours** | | |
| Hamilton’s Principle – Hamilton’s Equations - Other Variational Principles. | | | | | | | | | |
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| **Unit:4** | | | | **Hamilton – Jacobi Theory** | | | **12 hours** | | |
| Hamilton’s principal function –The Hamilton – Jacobi equation – Separability. | | | | | | | | | |
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| **Unit:5** | | | | **Canonical Transformations** | | | **12 hours** | | |
| Differential forms and generating functions –Special Transformations– Lagrange and Poisson brackets. | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | **2 hours** | | |
| Expert lectures, online seminars - webinars | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | **62 hours** | | |
| **Text Book(s)** | | | | | | | | | |
| 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, New Delhi, 2002. | | | | | | | | |
| 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/> | | | | | | | |
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| Course Designed By: Dr. N. SAKTHIVEL | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | M | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | L | M | S | L | M | S |
| **CO4** | S | S | M | S | M | S | S | M | S | S |
| **CO5** | M | M | S | S | S | S | M | S | S | L |

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

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| **Course code** | | | | **22AMAA23D** | | **Java Programming** | | **L** | | | **T** | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Core** | | **2** | | | **-** | **-** | **2** |
| **Pre-requisite** | | | | | | Basic Computer Languages | | **Syllabus Version** | | | | **2022-2023** | |
| **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 | | | | | | | | | | | | | |
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| **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 | | | | | | | | | K6 | |
| 4 | | | Evaluate the different programming languages | | | | | | | | | K5 | |
| 5 | | | Write codes of practical interest using composition of objects, operator overloading, inheritance and polymorphism | | | | | | | | | K6 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | |
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| **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, JVM. | | | | | | | | | | | | | |
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| **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 else if ladder, switch statement. The while statement, do statement, for statement- Jumps in loops –labeled loops. | | | | | | | | | | | | | |
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| **Unit:3** | | | | | **Classes, Objects and Input/output Files** | | | | **7 hours** | | | | |
| Introduction: Defining a class- Fields Declaration-Creating Objects-Assessing 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. | | | | | | | | | | | | | |
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| **Unit:5** | | | | | **Applet** | | **7 hours** | | | | | | |
| Introduction-Preparing to Applets-Building Applet code-Applet life cycle-Creating an executable Applet- Passing parameters to Applets-Displaying numerical values-Getting input from the user. | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | **2 hours** | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | |
|  | | | | | **Total Lecture hours** | | **37 hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | |
| 1 | E. Balagurusamy, Programming with JAVA a primer (Third edition), Tata McGraw-Hill Education Private Limited, New Delhi, 2007. | | | | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | | | | |
| 1 | E. Balagurusamy, Programming with JAVA a Primer (Fourth edition), Tata McGraw-Hill, New Delhi, 2010. | | | | | | | | | | | | |
| 2 | M. Siple, The Complete Guide to JAVA Database Programming, Tata McGraw-Hill, New York,1998. | | | | | | | | | | | | |
| 3 | P. Koparkar, JAVA for you, Tata McGraw-Hill, New Delhi, 2001 | | | | | | | | | | | | |
| 4 | H. Schildt, The Complete Reference - Java 2.0 (Fourth Edition), Tata McGraw-Hill, Berkeley, 2001 | | | | | | | | | | | | |
| 5 | K. Arnold, J. Gosslings and D. Holmes, The JAVA Programming Language, Addison Wesley Professional, New Jersey, 2005. | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | |
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| Course Designed By: Dr. N NITHYADEVI | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | M | M | M | M | M | L | M |
| **CO3** | S | S | S | S | S | S | S | S | S | S |
| **CO4** | S | S | M | M | M | M | S | M | M | M |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **Course code** | | | | | **22AMAA23P** | | | | **Practical II : Java Programming** | | | | | | | **L** | | | **T** | | **P** | | **C** |
| **Core/Elective/Supportive** | | | | | | | | | **Core** | | | | | | | **-** | | | **-** | | **4** | | **2** |
| **Pre-requisite** | | | | | | | | | C, C++ Programming | | | | | | | **Syllabus Version** | | | | **2022-2023** | | | |
| **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 | | | | | | | | | | | | | | | | | | | | | | | |
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| **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 | | | | | | | | | | | | | | | | | | K6 | | |
| 4 | | | Evaluate the different programming languages | | | | | | | | | | | | | | | | | | K5 | | |
| 5 | | | Write codes of practical interest using composition of objects, operator overloading, inheritance and polymorphism | | | | | | | | | | | | | | | | | | K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | | | | | | | | | |
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|  | | | | | | **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/> | | | | | | | | | | | | | | | | | | | | | |
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| Course Designed By: Dr.N.NITHYADEVI | | | | | | | | | | | | | | | | | | | | | | | |
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| **COs** | | | **PO1** | | | **PO2** | **PO3** | | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | | | **PO10** | | | |
| **CO1** | | | S | | | S | M | | M | M | M | M | M | M | | | M | | | |
| **CO3** | | | S | | | S | S | | S | S | S | M | S | S | | | M | | | |
| **CO3** | | | S | | | S | M | | L | S | M | S | S | L | | | S | | | |
| **CO4** | | | S | | | S | S | | S | S | S | S | S | S | | | S | | | |
| **CO5** | | | S | | | S | S | | S | L | S | S | S | S | | | S | | | |

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

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| **Course code** | | | | | | **21AMAA2EC** | | | | | **LINEAR ALGEBRA** | | | | | | | | **L** | | | | **T** | | **P** | | **C** |
| **Core/Elective/Supportive** | | | | | | | | | | | **Elective** | | | | | | | | **4** | | | | **-** | | **-** | | **4** |
| **Pre-requisite** | | | | | | | | | | | Linear equations, matrix theory | | | | | | | | **Syllabus Version** | | | | | **2021-2022** | | | |
| **Course Objectives:** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| The main objectives of this course are to:  1. 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 learn about canonical forms of linear transformations, diagonalizations of linear transformations and determinants.  3. understand the applications of Linear Algebra in Machine Learning. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | 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 | | | | | | | | | | | | | | | | | | | | | K6 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | | | | **Linear Transformations** | | | | | | | | | | | | | | **12 hours** | | | | | | |
| Linear transformations – Isomorphism of vector spaces – Representations of linear transformations by matrices – Linear functionals. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | | | **Algebra Of Polynomials** | | | | | | | | | | | | | **12 hours** | | | | | | | |
| The algebra of polynomials –Polynomial ideals - The prime factorization of a polynomial - Determinant functions. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | | | | **Determinants** | | | | | | | | | | | **12 hours** | | | | | | | | | |
| Permutations and the uniqueness of determinants – Classical adjoint of a (square) matrix – Inverse of an invertible matrix using determinants – Characteristic values – Annihilating polynomials. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | | | **Diagonalization** | | | | | | | | | | | **12 hours** | | | | | | | | | |
| Invariant subspaces – Simultaneous triangulations – Simultaneous diagonalization – Direct-sum decompositions – Invariant direct sums – Primary decomposition theorem. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | | | **The Rational and Jordan forms** | | | | | | | | | | **12 hours** | | | | | | | | | | |
| Cyclic subspaces – Cyclic decompositions theorem (Statement only) – Generalized Cayley – Hamilton theorem - Rational forms – Jordan forms. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | | | **Contemporary Issues** | | | | | | | | | | **2 hours** | | | | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | **Total Lecture hours** | | | | | | | | | | **62 hours** | | | | | | | | | | |
| **Text Book** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | K. Hoffman and R. 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, Prentice-Hall of India Pvt. Ltd., New Delhi, 2009. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | G. Strang*,* Introduction to Linear Algebra, SecondEdition, Prentice Hall of India Pvt. Ltd, New Delhi, 2013. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | S. Kumaresan, Linear Algebra: A Geometric Approach**,** Prentice-Hall of India Pvt. Ltd, New Delhi, 2000. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | M. T. Nair and A. Singh, Linear Algebra, Springer, Singapore, 2018. | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | | | | | | | | | | | | | | |
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| Course Designed By: Dr.P.DHANALAKSHMI | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | | | | **PO1** | | | **PO2** | **PO3** | **PO4** | | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | | | | | | **PO10** | | | |
| **CO1** | | | | S | | | S | M | S | | M | S | S | M | S | | | | | | S | | | |
| **CO3** | | | | S | | | M | S | S | | S | M | S | S | L | | | | | | M | | | |
| **CO3** | | | | S | | | S | S | S | | M | S | M | M | M | | | | | | S | | | |
| **CO4** | | | | M | | | S | S | L | | S | S | S | S | S | | | | | | S | | | |
| **CO5** | | | | S | | | S | L | S | | S | S | S | L | S | | | | | | M | | | |

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

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| **Course code** | | | | **21AMAA2ED** | GRAPH THEORY | **L** | | **T** | | | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Elective** | **4** | | **-** | | | | **-** | **4** |
| **Pre-requisite** | | | | | Basic knowledge of linear algebra | **Syllabus Version** | | | | **2021-2022** | | | |
| **Course Objectives:** | | | | | | | | | | | | | |
| The main objectives of this course are to:  1. teach the fundamental mathematical structures used to model pairwise relations between objects.  2. motivate the students with some basic concepts of graph theory including cycles, matchings, colourings, connectivity, and extremal graphs. | | | | | | | | | | | | | |
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| **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 and  apply principles and concepts of graph theory in practical situations. | | | | | | | | K5  K6 | | |
| K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 – Create | | | | | | | | | | | | | |
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| **Unit:1** | | | | An Introduction To Graphs | | | | | **12 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**: Characterisations 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. | | | | | | | | | | | | | |
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| **Unit:2** | | | | Connectivity | | | | | **12 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 . | | | | | | | | | | | | | |
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| **Unit:3** | | | | Eulerian And Hamiltonian Graphs | | | **12 hours** | | | | | | |
| Charecterisations 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. | | | | | | | | | | | | | |
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| **Unit:4** | | | | **Independence** | | | **12 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. | | | | | | | | | | | | | |
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| **Unit:5** | | | | **Planar Graphs** | | | **12 hours** | | | | | | |
| Planar Embedding – Euler’s Formula – Maximum Planar Graphs – Geometric dual – Characterisations of Planar Graphs – DMP Planarity Algorithm – Colouring in Planar Graphs – Face Colouring. | | | | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | **2 hours** | | | | | | |
| Expert lectures, online seminars – webinars | | | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | **62 hours** | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | |
| 1 | M. Murugan, Graph Theory and Algorithms, Second Edition, Muthali Publishing House, Chennai, 2018. | | | | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | | | | |
| 1 | J.A. Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillan Co., London, 1976. | | | | | | | | | | | | |
| 2 | R. Balakrishnan and K. Ranganathan, Text Book of Graph Theory, Springer, New York, 2000. | | | | | | | | | | | | |
| 3 | D. B. West, Introduction to Graph Theory, Prentice Hall of India, New Delhi, 2001. | | | | | | | | | | | | |
| 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> | | | | | | | | | | | |
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| Course Designed By: Dr.P.JAYARAMAN | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | M | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | M | M | S | L | L | S |
| **CO4** | S | S | M | S | M | S | S | M | S | S |
| **CO5** | M | L | S | S | S | S | M | S | S | M |

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

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| **Course code** | | | | | | **22AMAA33A** | | | | **Topology** | | | | | | | | | **L** | | | | **T** | | **P** | | **C** |
| **Core/Elective/Supportive** | | | | | | | | | | **Core** | | | | | | | | | **4** | | | | **1** | | **-** | | **4** |
| **Pre-requisite** | | | | | | | | | | **Basic Real analysis** | | | | | | | | | **Syllabus Version** | | | | | **2022-2023** | | | |
| **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 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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 | | | | | | | | | | | | | | | | | | | | | 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | | | **Continuous Functions** | | | | | | | | | | | | | **14 hours** | | | | | | | |
| Continuous functions - The product topology**-**The metric topology - Sequence lemma- Uniform limit theorem. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | | | **Contemporary Issues** | | | | | | | | | | **2 hours** | | | | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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|  | | | | | | | **Total Lecture hours** | | | | | | | | | | **75 hours** | | | | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | James R. Munkres, Topology, Second Edition, Prentice – Hall of India, Private Ltd, New Delhi, 2015. | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | G.F.Simmons, Introduction to Topology and Modern Analysis, TataMcGraw-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** | **PO8** | **PO9** | | | | | | **PO10** | | | |
| **CO1** | | | | S | | | S | M | | M | S | S | S | S | M | | | | | | M | | | |
| **CO3** | | | | S | | | S | S | | S | S | M | S | M | S | | | | | | S | | | |
| **CO3** | | | | S | | | L | S | | M | M | S | S | S | S | | | | | | L | | | |
| **CO4** | | | | S | | | S | S | | S | S | M | S | L | S | | | | | | S | | | |
| **CO5** | | | | S | | | S | S | | S | S | S | S | S | S | | | | | | S | | | |

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

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| **Course code** | | | | **21AMAA33B** | | **FLUID DYNAMICS** | **L** | | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Core** | **3** | | | | | **1** | | **-** | **4** |
| **Pre-requisite** | | | | | | Basic Mechanics | **Syllabus Version** | | | | | | **2021-2022** | | |
| **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 | | | | | | | | | | | | | | | |
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| **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 | |
| 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 | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | | **Bernoull’s Equation** | | | | | | **12 hours** | | | | |
| Introductory Notions – Velocity- Stream Lines and Path Lines- Stream Tubesand 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. | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | **Equations of Motion** | | | | | **12 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. | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | | **Two Dimensional Motion** | | | | **12 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). | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | **Viscous Flows** | | | | **12 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. | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | **Laminar Boundary Layer in Incompressible Flow** | | | **12 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. | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | **2 hours** | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | |
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|  | | | | | **Total Lecture hours** | | | **62 hours** | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | |
| 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, David Van Nostrand Company, London, 1968. | | | | | | | | | | | | | | |
| 3 | S. W. Yuan, Foundations of Fluid Mechanics, Prentice – Hall, New Delhi, 1976. | | | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | | | |
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| Course Designed By: Dr. N NITHYADEVI | | | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | M | S | S | S | S |
| **CO3** | S | S | S | S | M | S | S | M | S | S |
| **CO3** | S | S | M | S | S | S | S | S | L | S |
| **CO4** | S | L | S | L | S | S | S | M | S | M |
| **CO5** | S | S | M | S | S | M | S | S | M | S |

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

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| **Course code** | | **21AMAA33C** | | **MATHEMATICAL METHODS** | **L** | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | **Core** | **3** | | | **1** | | - | **4** |
| **Pre-requisite** | | | Basic concepts of calculus, initial value problems,  boundary value problems and linear transformations | | **Syllabus Version** | | | | **2021-**  **2022 onwards** | | |
| **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. | | | | | | | | | | | |
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| **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 | | | | | | | | | | | |
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| **Unit:1** | | **Integral Equations** | | | | | **12 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. | | | | | | | | | | | |
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| **Unit:2** | | **Applications of Integral Equations** | | | | | **12 hours** | | | | |
| Application to ordinary differential equation - Initial value problems, boundary value problems -  Singular integral equations - Abel integral equation. | | | | | | | | | | | |
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| **Unit:3** | | **Fourier Transforms** | | | | **12 hours** | | | | | |
| Fourier Transforms, Fourier sine and cosine transforms – Fourier transforms of derivatives -  convolution integral – Parseval’s Theorem - Solution of Laplace Equations by Fourier transform. | | | | | | | | | | | |
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| **Unit:4** | | **Hankel Transforms** | | | | **12 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. | | | | | | | | | | | |
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| **Unit:5** | | **Calculus of Variations** | | | | **12 hours** | | | | | |
| The method of variations in problems with fixed boundaries: Variation and its properties -  Euler's equation - Functionals of the form ∫ F(x,y1,y2,..., yn,y1',y2',...yn')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** | **62 hours** | | **Text Books** | | | | | 1 | R.P. Kanwal, Linear Integral Equations: Theory and Technique, Second Edition, Birkhauser,  Boston, 1997. | | | | 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,  1970. | | | |  | | | | | **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, 2000. | | | |  | | | | | **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 | | | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | L | S | S | S | S | S | M | S | S |
| **CO3** | S | S | S | S | M | M | S | M | L | M |
| **CO4** | S | S | L | S | M | S | S | M | S | S |
| **CO5** | M | M | S | S | S | S | M | S | S | M |

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

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| **Course code** | | | | **21AMAA33D** | **MATLAB** | **L** | | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **2** | | | | | **-** | | **-** | **2** |
| **Pre-requisite** | | | | | Basics of calculus, linear algebra, and differential equations. | **Syllabus Version** | | | | | | **2021-2022** | | |
| **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 | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | |  | |
| 2 | | | learn how to use the for-loop and the while-loop | | | | | | | | | |  | |
| 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. | | | | | | | | | | 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 | | | | | | | | | | | | | | |
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| **Unit:1** | | | | **Introduction** | | | | | | **4 hours** | | | | |
| Introduction - Basics of MATLAB : MATLAB windows-On-line help- Input – output- File types – Platform dependence – General commands | | | | | | | | | | | | | | |
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| **Unit:2** | | | | **Interactive Computation** | | | | | **4 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 | | | | | | | | | | | | | | |
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| **Unit:3** | | | | **Programming In** **Matlab:** **Scripts and Functions** | | | | **4 hours** | | | | | | |
| Script files – Functions files-Language-specific Features – Advanced Data Objects. | | | | | | | | | | | | | | |
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| **Unit:4** | | | | **Applications: Algebraic Equations** | | | | **4 hours** | | | | | | |
| Linear Algebra - Solving a linear system –Gaussian elimination– Finding Eigen values and Eigen vectors –Generalized eigenvalue problem– Matrix Factorizations-Curve Fitting and Interpolation. | | | | | | | | | | | | | | |
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| **Unit:5** | | | | **Applications:** **Data Analysis, Differential Equations** | | | **4 hours** | | | | | | | |
| Data Analysis and Statistics. **Differential Equations** : Numerical Integration (Quadrature) – Ordinary Differential Equations – Nonlinear Algebraic Equations. | | | | | | | | | | | | | | |
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| **Unit:6** | | | | **Contemporary Issues** | | | **2 hours** | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | |
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|  | | | | **Total Lecture hours** | | | **22 hours** | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | |
| 1 | Rudra Pratap**,** Getting Started with MATLAB-A Quick Introduction for Scientists and Engineers, Oxford University Press, New Delhi, 2006. | | | | | | | | | | | | | |
| 2 | A. Gilat, MATLAB An Introduction with Application, John Wiley & Sons, Singapore, 2004. | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | | |
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| Course Designed By: Dr.N.SAKTHIVEL | | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | M | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | M | M | S | L | M | S |
| **CO4** | S | S | L | S | M | S | S | M | S | S |
| **CO5** | M | M | S | S | S | S | L | S | S | M |

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

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| **Course code** | | | | **21AMAA33P** | **Practical III : MATLAB** | **L** | | **T** | | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **-** | | **-** | | | **4** | **2** |
| **Pre-requisite** | | | | | Basic programming knowledge | **Syllabus Version** | | | | **2021-2022** | | |
| **Course Objectives:** | | | | | | | | | | | | |
| The main objectives of this course are to:   1. provide 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. | | | | | | | | | | | | |
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| **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 | | | | | | | | 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 | | | | | | | | | | | | |
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|  | | **Course Content** | | | | | | |  | | | |
| 1 | | | Plotting a function. | | | | | | | | | |
| 2 | | | Polar plot. | | | | | | | | | |
| 3 | | | Matrix Manipulations. | | | | | | | | | |
| 4 | | | Straight line fit. | | | | | | | | | |
| 5 | | | Exponential curve fitting. | | | | | | | | | |
| 6 | | | Solving a first-order linear ODE. | | | | | | | | | |
| 7 | | | Solving a second-order nonlinear ODE. | | | | | | | | | |
| 8 | | | Solving nonlinear algebraic equations. | | | | | | | | | |
| **Total Practical hours** | | | | | | | **40 hours** | | | | | |
| **Related Online Contents** | | | | | | | | | | | | |
| 1 | <https://nptel.ac.in/courses/103/106/103106118/> | | | | | | | | | | | |
| 2 | <https://swayam.gov.in/nd1_noc20_ma40/preview> | | | | | | | | | | | |
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| Course Designed By: Dr.N.SAKTHIVEL | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | S | M |
| **CO3** | M | M | S | S | S | S | S | S | M | S |
| **CO3** | S | S | S | S | L | M | S | M | L | M |
| **CO4** | S | S | L | S | M | S | S | S | M | S |
| **CO5** | M | M | S | S | S | S | M | S | S | S |

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

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| **Course code** | | | | **21AMAA3EE** | | **FUZZY SET THEORY** | **L** | | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Elective** | **4** | | | | | **-** | | **-** | **4** |
| **Pre-requisite** | | | | | | **Sets-Mapping- Functions** | **Syllabus Version** | | | | | | **2021-2022** | | |
| **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.  3. learn to make decision in the existing models in fuzzy environment. | | | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | | | | |
| 1 | | | know about fuzzy sets and operations and also able to observe the connection between fuzzy sets and crisp sets | | | | | | | | | | | K2 | |
| 2 | | | familiar with fuzzy relations and the properties of these relations. | | | | | | | | | | | K3 | |
| 3 | | | formulate a system and make a decision in various types of 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, economics, communications | | | | | | | | | | | K5 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | | **Crisp Sets And Fuzzy Sets** | | | | | | **12 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. | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | **Operations On Fuzzy Sets** | | | | | **12 hours** | | | | | |
| Standard fuzzy operations – Union, intersection and complement – properties De. Morgan's laws - α–Cuts of fuzzy operations. | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | | **Fuzzy Relations** | | | | **12 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. | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | **Decision Making In Fuzzy Environments** | | | | **12 hours** | | | | | | |
| General Discussion – Individual Decision making – multi person decision making – multi criteria decision making – multi stage decision making – fuzzy ranking methods – fuzzy linear programming. | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | **Applications** | | | **12 hours** | | | | | | | |
| Medicine – Economics – Fuzzy Systems and Genetic Algorithms – Fuzzy Regression – Interpersonal Communication – Other Applications. | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | **2 hours** | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | |
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|  | | | | | **Total Lecture hours** | | | **62 hours** | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | |
| 1 | G. J. Klir and B. Yuan , Fuzzy sets and Fuzzy Logic Theory and Applications, PHI Leaning Private Limited, New Delhi , 2009. | | | | | | | | | | | | | | |
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| **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, McGraw Hill, New York, 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 Pvt. Limited, New Delhi, 2013. | | | | | | | | | | | | | | |
| 5 | K. Pundir and R. Pundir, Fuzzy Sets and their Application, Pragati Edition, Meerut, 2012. | | | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | | | |
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| Course Designed By: Dr.P.DHANALAKSHMI | | | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | S | S | S | S | S | S | S |
| **CO3** | S | S | M | S | S | L | S | S | M | S |
| **CO3** | S | M | S | S | M | S | S | S | S | M |
| **CO4** | S | S | S | L | S | M | S | S | L | S |
| **CO5** | S | S | S | S | M | S | S | M | S | S |

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

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| **Course code** | | | | **21AMAA3ED** | | **DISCRETE MATHEMATICS** | **L** | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Elective** | **4** | **-** | | **-** | **4** |
| **Pre-requisite** | | | | | | **Logics, Permutations, Relations** | **Syllabus Version** | | **2021-2022** | | |
| **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 | | | | | | | | | | | |
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| **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 | |
| 3 | | | construct mathematical arguments using logical connectives and quantifiers | | | | | | | K6 | |
| 4 | | | Implement the algebraic and discrete mathematical theory in programming automata | | | | | | | K3 | |
| 5 | | | Model finite state machines using Boolean algebra | | | | | | | K6 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | |
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| **Unit:1** | | | | | **The Foundations: Logic and Proofs** | | **12 hours** | | | | |
| Propositional Logic - Applications of Propositional Logic - Propositional Equivalences- Predicates and Quantifiers – Nested Quantifiers. Algorithms: The Growth of Functions. | | | | | | | | | | | |
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| **Unit:2** | | | | | **Counting and Advanced Counting Techniques** | | **12 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. | | | | | | | | | | | |
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| **Unit:3** | | | | | **Boolean Algebra and Modeling Computations** | | **12 hours** | | | | |
| Boolean Functions - Representing Boolean Functions - Logic Gates- Minimization of Circuits Finite- State machines with Output - Finite - State machines with No Output - Turing Machines. | | | | | | | | | | | |
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| **Unit:4** | | | | | **Coding Theory** | | **12 hours** | | | | |
| Introduction to Coding - Linear Codes- Cyclic codes- Special Cyclic codes. | | | | | | | | | | | |
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| **Unit:5** | | | | | **Further Applications of Algebra** | | **12 hours** | | | | |
| Semi group- Semigroup and Automata - Semigroup and formal Languages- Linear Recurring sequences. | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | **2 hours** | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | |
|  | | | | | | | | | | | |
|  | | | | | **Total Lecture hours** | | **62 hours** | | | | |
| **Text Book(s)** | | | | | | | | | | | |
| 1 | K. H. Rosen, Discrete Mathematics and its Applications, Seventh Edition, McGraw Hill Education, New York, 2012. | | | | | | | | | | |
| 2 | R. Lidl and G. Pilz, Applied Abstract Algebra, Second Edition, Springer-Verlag, New York, 1998. | | | | | | | | | | |
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| **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. Trembley and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw-Hill, New Delhi, 2003. | | | | | | | | | | |
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| **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/> | | | | | | | | | |
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| Course Designed By: Dr. M. SUVINTHRA | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | S | S | S | S | S | M |
| **CO3** | S | S | S | S | S | M | S | M | S | S |
| **CO3** | S | S | S | L | M | S | S | S | L | S |
| **CO4** | S | S | S | S | S | M | S | S | S | M |
| **CO5** | S | S | S | S | S | S | S | S | S | S |

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

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| **Course code** | | | | **21AMAA43A** | | **FUNCTIONAL ANALYSIS** | **L** | | | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Core** | **3** | | | | **1** | | **-** | **4** |
| **Pre-requisite** | | | | | | Linear spaces – Bases – Linear transformations. Metric spaces – Completeness – Compactness – Continuous functions. | **Syllabus Version** | | | | | **2021-2022** | | |
| **Course Objectives:** | | | | | | | | | | | | | | |
| The main objectives of this course are to:  1.Introduce the basic concepts and theorems on Banach and Hilbert spaces. of functional analysis and its  significant applications in many area  2. enhance research, inquiry and analytical thinking abilities  3. provide a strong background to gain knowledge of quantum computing | | | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | | | |
| 1 | | | familiar with Banach spaces and related theorems. | | | | | | | | | | K2 | |
| 2 | | | identify the Hilbert spaces, orthogonal set and orthonormal set. | | | | | | | | | | K3 | |
| 3 | | | analyse and appreciate the significance of Hahn Banach theorem, Open mapping theorem and Uniform boundedness principle. | | | | | | | | | | K4 | |
| 4 | | | prove and thoroughly explain theorems using operators | | | | | | | | | | K5 | |
| 5 | | | know the fundamentals of spectral theory and also realize its uses | | | | | | | | | | K3 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | |
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| **Unit:1** | | | | | **Banach Spaces** | | | | **13 hours** | | | | | |
| Normed spaces - Banach spaces - properties - Continuous linear transformation – Hahn Banach theorem and its consequences. | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | **Fundamental Theorems** | | | **12 hours** | | | | | | |
| Dual spaces - The natural embedding of N in N\*\* - Uniform boundedness principle – Open mapping theorem – Closed graph theorem – The conjugate of an operator | | | | | | | | | | | | | | |
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| **Unit:3** | | | | | **Hilbert Spaces** | | | | | **12 hours** | | | | |
| Hilbert space: Definition and properties – Orthogonal complements and direct sums – Orthonormal sets– Series related to orthonormal sets– Maximal orthonormal sets– Projection theorem – Representation of functionals on Hilbert spaces. | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | **Operators On Hilbert Spaces** | | | | | **11 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 operator. | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | **Banach Algebras** | | | | | **12 hours** | | | | |
| Introduction to Banach Algebra: Definition, Examples and some related basic results – Regular and singular elements – The spectrum – The formula for the spectral radius. | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | | | **2 hours** | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | |
|  | | | | | **Total Lecture hours** | | | | | **62 hours** | | | | |
| **Text Book** | | | | | | | | | | | | | | |
| 1 | G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw -Hill Publishing Company, New Delhi, 2004 | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | |
| 1 | M. T. Nair, Functional Analysis: A First Course, Prentice-Hall of India, New Delhi, 2004. | | | | | | | | | | | | | |
| 2 | B. V. Limaye, Functional Analysis, Third edition, New Age International, New Delhi, 2017 | | | | | | | | | | | | | |
| 3 | G. Bachman and L. Narici, Functional Analysis, Dover Publications, New York, 2000. | | | | | | | | | | | | | |
| 4 | E. Kreyszig, Introduction to Functional Analysis with Applications, Wiley India, New Delhi, 2007. | | | | | | | | | | | | | |
| 5 | E. S. Suhubi, Functional Analysis, Springer, New Delhi, 2009. | | | | | | | | | | | | | |
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| **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> | | | | | | | | | | | | |
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| Course Designed By: Dr. P. DHANALAKSHMI | | | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | S | M | S | S | M | M | S | S |
| **CO3** | S | S | S | M | S | M | S | S | S | M |
| **CO3** | S | M | S | L | S | S | S | M | S | L |
| **CO4** | S | S | M | M | S | S | S | L | S | S |
| **CO5** | S | S | S | S | M | S | S | M | S | S |

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

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| **Course code** | | | | | **22AMAA43B** | | | **OPTIMIZATION TECHNIQUES** | | | | | | | **L** | | | **T** | | | **P** | | **C** |
| **Core/Elective/Supportive** | | | | | | | | **Core** | | | | | | | **4** | | | **1** | | | **-** | | **4** |
| **Pre-requisite** | | | | | | | | NIL | | | | | | | **Syllabus Version** | | | | **2022-2023** | | | | |
| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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 | | | | | | | | | | | | | | | | | | | K5 | | | |
| 6 | using optimization techniques to solve many practical problems. | | | | | | | | | | | | | | | | | | | K6 | | | |
| K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **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. | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | | | | | | | | | **2 hours** | | | | | | | |
| Expert lectures, online seminars – webinars | | | | | | | | | | | | | | | | | | | | | | | |
| **Total Lecture hours** | | | | | | | | | | | | | | | | **75 hours** | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | Hamdy A. Taha, Operations Research, 8thEdition, Prentice–Hall of India private Limited, New Delhi, 2007. | | | | | | | | | | | | | | | | | | | | | |
| 2 | | Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, 11th Edition, Sultan Chand & Sons, Educational Publishers, New Delhi , 2003. | | | | | | | | | | | | | | | | | | | | | |
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| **Reference Books** | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | | Prem Kumar Gupta.Er, Hira.D.S. Operations Research, 7th Edition, S.Chand & Company Pvt.Ltd., 2014. | | | | | | | | | | | | | | | | | | | | | |
| 2 | | Panneerselvam.R, Operations Research, 2nd Edition, PHI Learning Private Limited, Delhi, 2015 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | Hiller.F.S and Lieberman.J, Introduction to Operation Research ,7thEdition, Tata–MCGraw Hill Publishing Company, New Delhi, 2001. | | | | | | | | | | | | | | | | | | | | | |
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| **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 | | | | | | | | | | | | | | | | | | | | |
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| Course Designed By: Dr.P.JAYARAMAN | | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | | | | | **PO1** | | **PO2** | **PO3** | | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | | | **PO10** | | | | |
| **CO1** | | | | | S | | S | M | | S | S | M | M | S | M | | | S | | | | |
| **CO3** | | | | | M | | L | S | | S | S | S | S | M | S | | | S | | | | |
| **CO3** | | | | | S | | S | S | | S | M | M | S | S | S | | | M | | | | |
| **CO4** | | | | | S | | S | L | | S | M | S | S | S | L | | | S | | | | |
| **CO5** | | | | | M | | M | S | | S | S | S | M | M | S | | | S | | | | |

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

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| **Course code** | | | | **21AMAA43C** | | **PYTHON PROGRAMMING** | **L** | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Core** | **2** | | **-** | | **-** | **2** |
| **Pre-requisite** | | | | | | Programming concepts | **Syllabus Version** | | | **2021-2022** | | |
| **Course Objectives:** | | | | | | | | | | | | |
| The main objectives of this course are to:   1. acquire knowledge in Python programming. 2. gain knowledge of mathematics and machine learning using python 3. develop python programs with control structures in mathematical modeling. | | | | | | | | | | | | |
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| **Expected Course Outcomes:** | | | | | | | | | | | | |
| On the successful completion of the course, student will be able to: | | | | | | | | | | | | |
| 1 | | | construct and execute basic programs in Python | | | | | | | | K2 | |
| 2 | | | apply python library | | | | | | | | K3 | |
| 3 | | | implement numerical programming, data handling through NumPy, Pandas, SciPy modules | | | | | | | | K4 | |
| 4 | | | implement visualization through matplotlib | | | | | | | | K5 | |
| 5 | | | analyze the significance of python program development environment by working on real world needs | | | | | | | | K4 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| **Unit:1** | | | | | **Introduction** | | | **4 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 | | | | | | | | | | | | |
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| **Unit:2** | | | | | **Dictionary** | | | **4 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. | | | | | | | | | | | | |
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| **Unit:3** | | | | | **Control Structures** | | | **4 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.. | | | | | | | | | | | | |
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| **Unit:4** | | | | | **Python Libraries** | | | **4 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, | | | | | | | | | | | | |
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| **Unit:5** | | | | | **Mathematics In Python** | | | **4 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, | | | | | | | | | | | | |
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| **Unit:6** | | | | | **Contemporary Issues** | | | **2 hours** | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | |
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|  | | | | | **Total Lecture hours** | | | **22 hours** | | | | |
| **Text Book(s)** | | | | | | | | | | | | |
| 1 | W. J. Chun, Core python programming, Second Edition, Prentice-Hall of India, New Delhi, 2007. | | | | | | | | | | | |
|  | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | |
| 1 | M. Summerfield, Programming in Python 3: A Complete Introduction to Python Language, Second Edition, Pearson Education, Boston, 2010. | | | | | | | | | | | |
| 2 | H. Fangohr, Introduction to Python for Computational Science and Engineering, 2015. | | | | | | | | | | | |
| 3 | A. B. Downey, Think Python: How to Think Like a Computer Scientist, Second Edition, Shroff Publishers, Bengaluru, 2016. | | | | | | | | | | | |
| 4 | E. Duchesnay, T. Lofstedt and F. Younes, Statistics and Machine Learning in Python, 2020. | | | | | | | | | | | |
| 5 | John V Guttag, Introduction to Computation and Programming Using Python,  Prentice Hall of India, New Delhi, 2013. | | | | | | | | | | | |
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| **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 | | | | | | | | | | |
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| Course Designed By: Dr.P.DHANALAKSHMI | | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | S | S | M | M | S | M | M |
| **CO3** | M | M | S | S | S | S | S | S | S | S |
| **CO3** | S | S | S | S | M | M | S | L | M | S |
| **CO4** | S | S | M | S | M | S | S | M | S | S |
| **CO5** | M | L | S | S | S | S | M | S | S | L |

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

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| **Course code** | | | **21AMAA43P** | | **Practical IV: PROGRAMMING IN PYTHON** | **L** | | **T** | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | **Core** | **-** | | **-** | | **4** | **2** |
| **Pre-requisite** | | | | | Basic computer knowledge- Programming concepts | **Syllabus Version** | | | **2021-2022** | | |
| **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.  3. apply SciPy functions | | | | | | | | | | | |
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| **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. | | | | | | | | K3 | |
| 2 | | understand the various data structures available in Python programming language and apply them in solving computational problems. | | | | | | | | K3 | |
| 3 | | do testing and debugging of code written in Python. | | | | | | | | K3 | |
| 4 | | Plot graphs related to mathematical problems using python library | | | | | | | | K5 | |
| 5 | | Build frames with scipy | | | | | | | | K4 | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | |
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|  | | | | **Course Content** | | |  | | | | |
| 1. Use of strings in python 2. Use of different types of structures (list, dictionary, tuples) in python 3. Programs to understand the control structures of python 4. Handling of missing data 5. Programs for data structure algorithms using python – searching, sorting and hash tables 6. Use of SciPy in python 7. Plot different types of graphs using matplotlib | | | | | | | | | | | |
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|  | | | | **Total hours** | | | **40 hours** | | | | |
| **Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** | | | | | | | | | | | |
| 1 | https://docs.python.org/3/tutorial/index.html | | | | | | | | | | |
| 2 | https://www.python.org/doc/ | | | | | | | | | | |
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| Course Designed By: Dr. P. DHANALAKSHMI | | | | | | | | | | | |

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| **COs** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** |
| **CO1** | S | S | M | M | M | M | M | S | M | S |
| **CO3** | S | S | S | S | S | S | M | S | S | S |
| **CO3** | S | S | M | L | S | M | S | M | L | M |
| **CO4** | M | M | S | S | S | S | S | S | S | S |
| **CO5** | S | S | S | S | L | S | S | M | S | S |

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

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| **Course code** | | | | | | **21AMAA4EG** | | | **CONTROL THEORY** | | | | | | | | **L** | | | **T** | | | **P** | **C** | |
| **Core/Elective/Supportive** | | | | | | | | | **Elective** | | | | | | | | **3** | | | **1** | | | - | **4** | |
| **Pre-requisite** | | | | | | | | | Basic concepts from matrix, functional analysis and ordinary differential equations | | | | | | | | **Syllabus Version** | | | | | **2021-2022** | | | |
| **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 | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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 | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:1** | | | | | | **Observability** | | | | | | | | | | | | | **12 hours** | | | | | | |
| Linear Systems – Observability Grammian – Constant coefficient systems –Reconstruction kernel – Nonlinear Systems. | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:2** | | | | | | **Controllability** | | | | | | | | | | | | **12 hours** | | | | | | | |
| Linear systems – Controllability Grammian – Adjoint systems – Constant coefficient systems–Steering function – Nonlinear systems. | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | | | **Stability** | | | | | | | | | | **12 hours** | | | | | | | | | |
| Stability – Uniform stability – Asymptotic stability of linear systems - Linear time-varying systems – Perturbed linear systems – Nonlinear systems. | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | | **Stabilizability** | | | | | | | | | | **12 hours** | | | | | | | | | |
| Stabilization via linear feedback control – Bass method – Controllable subspace – Stabilization with restricted feedback. | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | | **Optimal Control** | | | | | | | | | **12 hours** | | | | | | | | | | |
| Linear time varying systems with quadratic performance criteria – Matrix Riccati equation – Linear time invariant systems – Nonlinear Systems. | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | | **Contemporary Issues** | | | | | | | | | **2 hours** | | | | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | | | | | | | | | | | |
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|  | | | | | | **Total Lecture hours** | | | | | | | | | **62 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. Hespanha**,** Linear Systems Theory, Princeton University Press, 2009. | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | S. Pickl and W. Krabs, Dynamical Systems\_Stability, Controllability and Chaotic Behavior, Springer-Verlag, Heidelberg, 2010. | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | | M.C. Joshi**,** Ordinary Differential Equations: Modern Perspective, Alpha Science Intl. Ltd., 2006. | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | C.T. Chen, Linear System Theory and Design, Third Edition, Oxford University Press, 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> | | | | | | | | | | | | | | | | | | | | | | |
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| Course Designed By: Dr. R. SAKTHIVEL | | | | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | | | | **PO1** | | **PO2** | **PO3** | | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | | | **PO9** | | | | **PO10** | | | |
| **CO1** | | | | S | | S | M | | S | S | M | M | S | | | M | | | | M | | | |
| **CO3** | | | | M | | L | S | | S | S | S | S | S | | | S | | | | S | | | |
| **CO3** | | | | S | | S | S | | S | M | M | S | L | | | M | | | | M | | | |
| **CO4** | | | | S | | S | M | | S | L | S | S | M | | | S | | | | S | | | |
| **CO5** | | | | M | | M | S | | S | S | S | M | S | | | S | | | | S | | | |

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

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| **Course code** | | | | | | **21AMAA4EH** | | | | | **ELEMENTS OF STOCHASTIC PROCESSES** | | | | | | | **L** | | | | | **T** | | **P** | | **C** |
| **Core/Elective/Supportive** | | | | | | | | | | | **Elective** | | | | | | | **4** | | | | | **-** | | **-** | | **4** |
| **Pre-requisite** | | | | | | | | | | | Probability | | | | | | | **Syllabus Version** | | | | | | **2021-2022** | | | |
| **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 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **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 | | |
| 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 | | | | | | | | | | | | | | | | | | | | | K5 | | |
| 5 | | | | Master the generalized Markov models and evaluate the pros and cons | | | | | | | | | | | | | | | | | | | | | K5 | | |
| **K1** - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Unit:1** | | | | | | | **Continuous-Time Markov Models** | | | | | | | | | | | | | | **12 hours** | | | | | | |
| Continuous Time Markov Chain, Examples, Transient Analysis, Occupancy Times, Limiting Behaviour. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Unit:2** | | | | | | | **Generalized Markov Models** | | | | | | | | | | | | | **12 hours** | | | | | | | |
| Renewal Process, Cumulative Process, Semi-Markov Process, Examples and Long term Analysis. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Unit:3** | | | | | | | **Queueing Models** | | | | | | | | | | | | **12 hours** | | | | | | | | |
| Queueing Systems, Single-Station Queues, Birth and Death queues with Finite and Infinite Capacity. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | | | **Queues and Networks** | | | | | | | | | | | | **12 hours** | | | | | | | | |
| M/G/1 and G/M/1 Queues and Network of Queues. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Unit:5** | | | | | | | **Brownian Motion** | | | | | | | | | | **12 hours** | | | | | | | | | | |
| Standard Brownian Motion, Brownian Motion and First Passage Times. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **Unit:6** | | | | | | | **Contemporary Issues** | | | | | | | | | | **2 hours** | | | | | | | | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | **Total Lecture hours** | | | | | | | | | | **62 hours** | | | | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| **COs** | | | | **PO1** | | | **PO2** | **PO3** | **PO4** | | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | | | | | | **PO10** | | | |
| **CO1** | | | | S | | | S | S | S | | S | M | S | S | S | | | | | | S | | | |
| **CO3** | | | | S | | | S | S | S | | M | S | S | M | S | | | | | | M | | | |
| **CO3** | | | | S | | | S | M | S | | S | S | S | S | L | | | | | | S | | | |
| **CO4** | | | | S | | | S | S | L | | S | S | S | S | S | | | | | | M | | | |
| **CO5** | | | | S | | | S | L | S | | S | M | S | S | M | | | | | | S | | | |

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

**SUPPORTIVE COURSES FOR OTHER DEPARTMENT STUDENTS**

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| **Course code** | | | | **21GS01** | **NUMERICAL METHODS** | **L** | **T** | | **P** | | **C** |
| **Core/Elective/Supportive** | | | | | **Supportive** | **1** | **1** | | **-** | | **2** |
| **Pre-requisite** | | | | | NIL | **Syllabus Version** | | | | **2021-2022** | |
| **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. | | | | | | 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 | | | work numerically on the ordinary differential equations using different methods through the theory of finite differences. | | | | | | K4 | | |
| 4 | | | Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations. | | | | | | K5 | | |
| 5 | | | Improve and implement stable and accurate numerical methods to solve linear systems of equations and find roots of linear and non-linear equations. | | | | | | K6 | | |
| K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit:1** | | | | **Solution of Numerical Algebraic and Transcendental Equations** | | | | **4 hours** | | | |
| The Bisection Method – Method of Successive approximations -Regula –falsi Method. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit:2** | | | | **Solution of Numerical Algebraic and Transcendental Equations** | | | | **4 hours** | | | |
| Newton’s Raphson Method - Convergence of Newton’s Method and rate of Convergence. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit:3** | | | | **Solution of Simultaneous Linear Algebraic Equations** | | | | **4 hours** | | | |
| Gauss elimination method-Gauss Jordan method – Jacobi Iterative method - Gauss Seidal method - Comparison of Gauss elimination and Gauss Seidal Iteration Method. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit:4** | | | | **Numerical Solution of Ordinary Differential Equations** | | | | **4 hours** | | | |
| Introduction-Power series approximations-Pointwise methods-Solution by Taylor seriesTaylor series method for simultaneous first order differential equations. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit:5** | | | | **Numerical Integration** | | | | **4 Hours** | | | |
| Introduction-Trapezoidal rule-Simpson’s one-third rule- Simpson’s three-eighths rule. | | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Unit:6** | | | | **Contemporary Issues** | | | | **2 hours** | | | |
| Expert lectures, online seminars - webinars | | | | | | | | | | | |
|  | | | | | | | | | | | |
|  | | | | **Total Lecture hours** | | | | **22 hours** | | | |
| **Text Book(s)** | | | | | | | | | | | |
| 1 | P. Kandasamy, K.Thilagavathy, K.Gunavathi, Numerical Methods, S. Chand & Company Ltd., New Delhi, 2003. | | | | | | | | | | |
| 2 | S.C.Gupta and P.C.Raymond, Numerical Methods for Engineers, Tata McGraw Hill, New Delhi, 2000. | | | | | | | | | | |
|  | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | |
| 1 | M.K.Venkataraman, Numerical Methods in Science and Engineering, The National publishing company, Fifth Edition, 1999. | | | | | | | | | | |
| 2 | S.S.Sastry, Introductory methods of Numerical Analysis, Prentice Hall of India, New Delhi, 1998. | | | | | | | | | | |
|  | | | | | | | | | | | |
| **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/ | | | | | | | | | |
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| Course Designed By: Dr.P.JAYARAMAN | | | | | | | | | | | |

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| **Course code** | | | | **21G144** | | **OPERATIONS RESEARCH** | **L** | | | | | **T** | | | **P** | **C** |
| **Core/Elective/Supportive** | | | | | | **Supportive** | **1** | | | | | **1** | | | **-** | **2** |
| **Pre-requisite** | | | | | | NIL | **Syllabus Version** | | | | | | **2021-2022** | | | |
| **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 | | | design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems. | | | | | | | | | | | K6 | | |
| K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate; K6 - Create | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| **Unit:1** | | | | | **Linear Programming Problem** | | | | | | **4 hours** | | | | | |
| Mathematical formulation – Illustrations on Mathematical formulation on Linear Programming Problems -Canonical and standard forms of Linear Programming Problem | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| **Unit:2** | | | | | **Transportation Problem** | | | | | **4 hours** | | | | | | |
| LP formulation of the TP - Solution of a TP - Finding an initial basic feasible solution (NWCM - LCM -VAM). | | | | | | | | | | | | | | | | |
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| **Unit:3** | | | | | **Assignment Problem** | | | | **4 hours** | | | | | | | |
| Solution methods of assignment problem – special cases in assignment problem. | | | | | | | | | | | | | | | | |
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| **Unit:4** | | | | | **Games and Strategies** | | | | **4 hours** | | | | | | | |
| Some basic terms - the maxi min-mini max principle -Games without saddle points | | | | | | | | | | | | | | | | |
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| **Unit:5** | | | | | **PERT and CPM** | | | **4 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** | | | **22 hours** | | | | | | | | |
| **Text Book(s)** | | | | | | | | | | | | | | | | |
| 1 | Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Thirteenth Edition, Sultan Chand and Sons, 2007. | | | | | | | | | | | | | | | |
| 2 | V. Sundaresan, K.S. Ganapathy Subramanian. and K. Ganesan. Resource Management Techniques, A.R. Publications, 2002. | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | |
| **Reference Books** | | | | | | | | | | | | | | | | |
| 1 | H.A. Taha, Operations Research: An introduction, Seventh Edition, Pearson Prentice Hall, 2002. | | | | | | | | | | | | | | | |
| 2 | Prem Kumar Gupta and D.S. Hira, Operations Research, Seventh Edition, S.Chand & Company Pvt.Ltd., 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> | | | | | | | | | | | | | | |
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| Course Designed By: Dr.P.JAYARAMAN | | | | | | | | | | | | | | | | |

**JOB ORIENTED CERTIFICATE COURSE-I**

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| **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. P. JAYARAMAN,  Assistant professor  Department of Applied Mathematics  Bharathiar University, Coimbatore-641046 Mobile: 9487762007  Email: jrmsathya@gmail.com | |
| **Inter / Intra Department Course** | | | | | | Intra Department | |
| **Duration of the Course** | | | | | | 30 hours | |
| **Eligibility** | | | | | | BSc Mathematics/BSc 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   * Have job opportunities on professional typesetting, latex paginator, template developer and etc. * 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** | | | | Practical | | | **2- hours** |
| **Module 8** | | | | Mathematical formulas. Main elements of math mode Mathematical symbols, Additional elements. | | | **3- hours** |
| **Module 9** | | | | Practical | | | **2- hours** |
| **Module 10** | | | | Fine–tuning mathematics, Drawing pictures with LATEX. Mathematical functions. | | | **3- hours** |
| **Module 11** | | | | Practical | | | **2- hours** |
| **Module 12** | | | | Graphics | | | **2- hours** |
|  | | | | **Total** | | | **30-hours** |
| **Book(s) for Study** | | | | | | | |
| 1 | “A Guide to LATEX” (Third Edition) by H.Kopka and P.W.Daly, Addison Wesley, London, 1999. | | | | | | |
|  | | | | | | | |
| **Book(s) for reference** | | | | | | | |
| 1 | “Math into LATEX” by G.Gratzer, Birkhauser, Boston, 1996. | | | | | | |
| 2 | L.Lamport , “Late, A Document preparation System” person Education, New Delhi,2006. | | | | | | |
|  | | | | | | | |
| **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**

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| **TITLE OF THE JOB ORIENTED**  **CERTIFICATE COURSE** | | | | | | SAGEMATH | |
| **Name of the Department** | | | | | | Applied Mathematics | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | Dr. P. JAYARAMAN,  Assistant professor  Department of Applied Mathematics  Bharathiar University, Coimbatore-641046 Mobile: 9487762007  Email: [jrmsathya@gmail.com](mailto:jrmsathya@gmail.com) | |
| **Inter / Intra Department Course** | | | | | | Intra Department | |
| **Duration of the Course** | | | | | | 30 hours | |
| **Eligibility** | | | | | | BSc Mathematics/BSc 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.) | | | | | | -- | |
| **Registration Procedure** | | | | | | -- | |
| **Job Opportunities:** | | | | | | | |
| On successful completion of the course, the students will be able to  Have job opportunities like professional engineering calculator developer and many more.  Take up profession in industrial sectors which hire mathematics graduates for tackling mathematically modelled problems using computational tools. | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
| The main objectives of this course are to make the candidates | | | | | | | |
| 1 | | | To learn one of the powerful open source software. | | | | |
| 2 | | | To visualize the mathematical concepts. | | | | |
| 3 | | | To get motivated to become a professional mathematician. | | | | |
| **Course Content** | | | | | Lecture / Project / Internship | | |
| **Module 1** | | | | Introduction by Using Sagemath as an Advanced Engineering Calculator. | | | **2- hours** |
| **Module 2** | | | | Evaluation of elementary functions (polynomials, square root, trigonometric, exponential, logarithmic etc) | | | **2- hours** |
| **Module 3** | | | | Basic usage in Combinatorics & Number theory. | | | **3- hours** |
| **Module 4** | | | | Plotting: simple plots of known functions, polar plotting, and plotting implicit functions. | | | **3-hours** |
| **Module 5** | | | | Contour Plots, Level Sets, Parametric 2D Plotting, Vector Fields Plotting, and Gradients. | | | **3- hours** |
| **Module 6** | | | | Advanced Plotting 3D Plots. | | | **2- hours** |
| **Module 7** | | | | Basic usages in Linear Algebra and Vector Calculus | | | **3- hours** |
| **Module 8** | | | | Basic usage in Real Analysis and Algebra. | | | **3- hours** |
| **Module 9** | | | | Current Contours (Advanced topics only for discussion) | | | **3- hours** |
| **Module 10** | | | | Learning Advanced Computing In Topics Selected Areas Like Numerical Analysis, Linear Algebra. | | | **3- hours** |
| **Module 11** | | | | Number Theory, Coding Theory, Cryptography, Graph Theory. | | | **3- hours** |
|  | | | | **Total** | | | **30-hours** |
| **Book(s) for Study** | | | | | | | |
| 1 | Gregory V. Bard. Sage for Undergraduates, American Mathematical Society. Publication Year: 2015, ISBN-10: 1-4704-1111-3, ISBN-13: 978-1-4704-1111-4. | | | | | | |
| **Book(s) for reference** | | | | | | | |
| 1 | [Paul Zimmermann](https://tales.as/authors/paul-zimmermann/) Computational Mathematics with Sage Math, Society for Industrial & Applied Mathematics,U.S. A , 2019. | | | | | | |
| **Related Online Contents** | | | | | | | |
| 1 | | <http://www.gregorybard.com/Sage.html>. | | | | | |
| 2 | | <http://users.rowan.edu/~nguyen/sage/SageMathAdviceforCalculus.pdf>. | | | | | |

**VALUE ADDED COURSE-I**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **MAPLE** | | | | | | | |
| **Name of the Department** | | | | | | Department of Applied Mathematics | |
| **Name of the Faculty Member i/c**  **With Complete Address with Phone and e-mail** | | | | | | Dr. M. Suvinthra  Assistant Professor  Department of Applied Mathematics  Bharathiar University  Coimbatore – 641 046  Ph: +91 89032 42282  e-mail ID: [suvinthra@gmail.com](mailto:suvinthra@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** | | | | | | 40 | |
| **Registration Procedure** | | | | | | Online mode/Offline mode via Bharathiar University Portal | |
| **Job Opportunities:** | | | | | | | |
| Getting exposed to Maple software will increase their opportunities to join computational laboratories involving mathematical manipulations. | | | | | | | |
| This course may be a motivation for the candidates to increase further reading and make professional entry in education technological companies who promote mathematics learning applications. | | | | | | | |
| **The objectives of the Course are:** | | | | | | | |
| The main objectives of this course are to: | | | | | | | |
| 1 | | | introduce the Maple software, its usage and applications | | | | |
| 2 | | | give an overview of how to use it to make numerical computations | | | | |
| 3 | | | promote the idea of using Maple software for expression manipulations | | | | |
| 4 | | | familiarize the software in solving symbolic computations | | | | |
| 5 | | | explore some aspects of the software for data interpretation, statistical computing and optimization using different packages | | | | |
| **Course Content** | | | | | Lecture / Practical / Project / Internship | | |
|  | | | | | | | |
| **Module 1** | | | | Introduction | | | **3-- hours** |
| **Module 2** | | | | Numerical computations – integer computations – exact arithmetic | | | **3-- hours** |
| **Module 3** | | | | Floating point approximations – arithmetic with special numbers – mathematical functions | | | **3-- hours** |
| **Module 4** | | | | Basic symbolic computations – assigning expressions to names | | | **3-- hours** |
| **Module 5** | | | | Basic types of Maple objects – expression sequences – lists – sets – operations on sets and lists – arrays – tables – strings | | | **3-- hours** |
| **Module 6** | | | | Expression manipulation – the simplify, factor, expand, convert, normal, combine, map, lhs and rhs commands – the numer and denom commands – the nops and op commands | | | **3-- hours** |
| **Module 7** | | | | Finding solutions – simple solve – verifying, restricting and exploring solutions | | | **3-- hours** |
| **Module 8** | | | | Polynomials – sorting and collecting – mathematical operations – coefficients and degrees – root finding and factorization | | | **3-- hours** |
| **Module 9** | | | | Calculus – differential equations: dsolve | | | **3-- hours** |
| **Module 10** | | | | The Maple packages – the student calculus1, linear algebra, matlab, statistics and linear optimization packages | | | **3-- hours** |
|  | | | |  | | | **30 hours** |
| **Book(s) for Study** | | | | | | | |
| 1 | Maple 8 Learning Guide*,* Waterloo Maple Inc, Waterloo, 2002. | | | | | | |
|  | | | | | | | |
| **Book(s) for reference** | | | | | | | |
| 1 | M. A. Abell and J. B. Braselton, Maple by Example, Academic Press, Amsterdam, 2005. | | | | | | |
| 2 | P. Adams, K. Smith and R. Vyborny, Introduction to Mathematics with Maple, World Scientific, New Jersey, 2004. | | | | | | |
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| **Related Online Contents** | | | | | | | |
| 1 | | <https://www.maplesoft.com/> | | | | | |
| 2 | | <http://ftp.informatik.rwth-aachen.de/maple/mplcrashcourse.htm> | | | | | |
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**VALUE ADDED COURSE-II**

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| **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. M. Suvinthra  Assistant Professor  Department of Applied Mathematics  Bharathiar University  Coimbatore – 641 046  Ph: +91 89032 42282  e-mail ID: [suvinthra@gmail.com](mailto:suvinthra@gmail.com) | |
| **Inter / Intra Department Course** | | | | Intra Department | |
| **Duration of the Course** | | | | 30 hours | |
| **Eligibility** | | | | BSc Mathematics/BSc 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 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** |
| **Book(s) for Study** | | | | | |
| 1 | R. S. Aggarwal, Quantitative Aptitude, Sultan Chand and Company, New Delhi, 2017. | | | | |
| 2 | K. M 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, Sultan Chand and Sons, New Delhi, 2003. | | | | |
| 13 | W. Feller, An Introduction to Probability Theory and its Applications, Wiley, New Delhi, 2012. | | | | |
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| **Book(s) 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, 1998. | | | | |
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| **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/> | | | | |
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