BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

B.TECH IN ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

COURSE INFORMATION SHEET

Course Code: MA24101
Course Title: Mathematics-I
Pre-requisite(s): -
Co- requisite(s): --
Credits: L: 3 T: 1 P: 0
Class schedule per week: 3 L, 1 T
Class: B.Tech.
Semester / Level: I/1
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	infinite sequences and series
	theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
	multivariable functions, partial differentiation, properties and applications of partial derivatives.
	integrals of multivariable functions viz. double and triple integrals with their applications
	properties like gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	decide the behavior of sequences and series using appropriate tests.
CO2	handle problems related to the theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
CO3	get an understanding of partial derivatives and their applications in finding maxima - minima problems.
CO4	apply the principles of integrals (multivariable functions viz. double and triple integrals) to solve a variety of practical problems in engineering and sciences.
CO5	get an understanding of gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions and demonstrate a depth of understanding in advanced mathematical topics, enhance and develop the ability of using the language of mathematics in engineering.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
MODULE – I: Sequences and Series Sequences, Convergence of Sequence. Series, Convergence of Series, Tests for Convergence: Comparison tests, Cauchy's Integral test, Ratio test, Cauchy's root test, Raabe's test, Gauss test, Alternating series, Leibnitz test, Absolute and Conditional Convergence.	**9**
MODULE – II: Matrices Rank of a Matrix, elementary transformations. Vectors, Linear Independence and Dependence of Vectors. Consistency of system of linear equations. Eigenvalues, Eigenvectors, Cayley - Hamilton theorem.	**9**
MODULE – III:: Advance Differential Calculus Function of several variables, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Chain rules, Jacobians and its properties, Taylor series for function of two variables, Maxima – Minima.	**9**
MODULE – IV: Advance Integral Calculus Double integrals, double integrals in polar coordinates, Change of order of integration, Triple Integrals, cylindrical and spherical coordinate systems, transformation of coordinates, Applications of double and triple integrals in areas and volumes.	**9**
MODULE – V: Vector Calculus Scalar and vector point functions, gradient, directional derivative, divergence, curl. Line Integral, Work done, Conservative field, Green's theorem in a plane, Surface and volume integrals, Gauss – divergence theorem, Stoke 's theorem.	**9**

TEXTBOOKS:

1. M. D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 11th edition, Pearson Educations, 2008E.
2. H. Anton, I. Brivens and S. Davis, Calculus, 10th Edition, John Wiley and sons, Singapore Pte. Ltd., 2013.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.

REFERENCE BOOKS:

1. M. J. Strauss, G. L. Bradley And K. J. Smith, Calculus, 3rd Ed, Dorling. Kindersley (India) Pvt. Ltd. (P Ed), Delhi, 2007.
2. David C. Lay, Linear Algebra and its Applications (3rd Edition), Pearson Ed. Asia, Indian Reprint, 2007.
3. Robert Wrede & Murray R. Spiegel, Advanced Calculus, 3rd Ed., Schaum's outline series, McGraw-Hill Companies, Inc.,2010.

4. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, Fourth Edition, 2011.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN --

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	√
CD	Simulation	

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MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO 1	3	3	2	2	1	0	0	0	0	0	1	2			
CO 2	3	3	2	2	2	0	0	0	0	0	1	2			
CO 3	3	3	2	2	1	0	0	0	0	0	1	2			
CO 4	3	3	3	3	2	1	0	0	0	0	1	2			
CO 5	3	3	2	3	2	1	1	1	1	1	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6
CO5	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course Code: MA24103
Course Title: Mathematics II
Pre-requisite(s): Mathematics - I
Co- requisite(s): --
Credits: L: 3 T: 1 P: 0
Class schedule per week: 3 L, 1 T
Class: B.Tech.
Semester / Level: II/1
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	various methods to solve linear differential equations of second and higher order
	special functions viz. Legendre's and Bessel's and different properties associated with them
	diverse mathematical techniques for solving partial differential equations of first order, along with their applications in wave and heat equations using Fourier series
	the theory of functions of a complex variable, complex differentiation and integration
	about random variables and elementary probability distribution

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	investigate the occurrence of ordinary differential equations in real-life problems and identify the suitable methods available for their solutions.
CO2	develop skills to solve and implement various forms of differential equations and special functions in diverse domains.
CO3	learn to solve various forms of partial differential equations arising in real-world.
CO4	gain an understanding of complex variable functions and their properties in science and engineering.
CO5	comprehend and apply the concept of probability distributions in solving problems related to uncertainty.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Ordinary Differential Equations – I Linear differential equations, Wronskian, Linear independence and dependence of solutions, Linear differential equations of 2nd and higher order with constant coefficients, Operator method, Euler – Cauchy's form of linear differential equation, Method of variation of parameters.	**9**
Module – II: Ordinary Differential Equations – II Ordinary and singular points of differential equation, Power and Frobenius' series solutions (root differ by non-integer and equal roots). Bessel's differential equation,	**9**

Bessel function of first kind and its important properties. Legendre's differential equation, Legendre's polynomial and its important properties.	
Module – III: Fourier series and Partial Differential Equations Fourier series: Euler formulae for Fourier series, Half range Fourier series. Partial Differential Equations: Method of separation of variables and its application in solving one dimensional wave and heat equations.	**9**
Module – IV: Complex Variable-Differentiation & Integration Function of a complex variable, Analyticity, Analytic functions, Cauchy – Riemann equations. Cauchy's theorem, Cauchy's Integral formula, Taylor and Laurent series expansions. Singularities and its types, Residues, Residue theorem.	**9**
Module – V: Applied Probability Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, variance. Introduction to Binomial, Poisson and Normal Distribution.	**9**

TEXTBOOKS:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, Fourth Edition, 2011.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing, 3rd Ed, 2009.
5. R. A. Johnson, I. Miller and J. Freund: Probability and Statistics for Engineers, PHI
6. S. C. Gupta and V. K. Kapoor: Fundamental of Mathematical Statistics, Sultan Chand and Sons

REFERENCE BOOKS:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
4. G. F. Simmons, Differential Equations with Applications and Historical Notes, TMH, 2nd ed., 2003.
5. P. L. Meyer: Introductory Probability and Statistical Applications, Oxford & IBH.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN –

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	√
CD 7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2	1	1	0	0	0	1	2			
CO2	3	3	2	3	2	1	1	0	0	1	1	2			
CO3	3	3	2	3	2	1	1	0	0	1	1	2			
CO4	3	2	2	2	2	1	1	0	0	1	1	2			
CO5	3	3	2	2	2	1	1	1	1	1	2	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6

CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6
CO5	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course Code: PH24101
Course Title: Physics
Pre-requisite(s): Intermediate Physics and Intermediate Mathematics
Co- requisite(s): Mathematics I
Credits: 4 L: 3 T: 1 P: 0
Class schedule per week: 4
Class: B.Tech.
Semester / Level: I
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students:

1.	The principles of physical optics and basic concept of fiber optics.
2.	Fundamental laws of electromagnetism leading to Maxwell's equations.
3.	The posulates of special theory of relativity, Lorenz transformation equation and their consequences: Einstein energy mass relation and relativistic energy-momentum relation
4.	The limitations of classical physics and basic concepts such as wave-particle duality, and working of quantum mechanics with the help of particles in a box problem
5.	Concepts of stimulated emission and working principle of laser with examples, concepts of nuclear physics and plasma physics

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	analyse the intensity variation of light due to polarization, interference and diffraction.
CO2	formulate and solve the problems on electromagnetism
CO3	explain and apply concepts of special theory of relativity and its consequences
CO4	Apply the concepts of quantum mechanics such as wave-particle duality and obtain the solution of simple quantum mechanical problems.
CO5	explain working principle of lasers and to summarize its applications, describe basic concepts of nuclear and plasma physics

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: **Physical Optics:** Polarization, Malus' Law, Brewster's Law, Double Refraction, Interference in thin parallel films, Interference in wedge-shaped layers, Newton's rings, Fraunhofer diffraction by single slit and double slit. Elementary ideas of fibre optics and application of fibre optic cables	**8**
Module – II:	

Electromagnetic Theory: Gradient, Divergence and Curl, Statement of Gauss theorem & Stokes theorem, Gauss's law, Applications, Concept of electric potential, Relationship between E and V, Polarization of dielectrics and dielctric constant, Boundary conditions for E & D, Gauss's law in magnetostatics, Ampere's circuital law, Boundary conditions for B & H, Equation of continuity, Displacement current, Maxwell's equations.	**8**
Module – III: **Special Theory of Relativity:** Introduction, Inertial frame of reference, Galilean transformations, Postulates, Lorentz transformations and its conclusions, Length contraction, time dilation, velocity addition, Mass change, Einstein's mass energy relation.	6
Module – IV: **Quantum Mechanics:** Planck's theory of black-body radiation, Compton effect, Wave-particle duality, De Broglie waves, Davisson and Germer's experiment, Uncertainty principle, Brief idea of Wave Packet, Wave Function and its physical interpretation, Schrodinger equation in one-dimension, free particle, particle in an infinite square well	9
Module – V **Modern Physics:** Laser-Spontaneous and stimulated emission, Einstein's A and B coefficients, Population inversion, Light amplification, Basic laser action, Ruby and He-Ne lasers, Properties and applications of laser radiation, Nuclear Physics: Binding Energy Curve, Nuclear Force, Liquid drop model, Introduction to Shell model, Applications of Nuclear Physics, Concept of Plasma Physics and its applications.	9

TEXTBOOKS:

1. A. Ghatak, Optics, 4th Edition, Tata Mcgraw Hill, 2009
2. Mathew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2001
3. Arthur Beiser, Concept of Modern Physics, 6th edition, Tata McGraw- Hill, 2009
4. F. F. Chen, Introduction to Plasma Physics and controlled Fusion, Springer, Edition 2016.

REFERENCE BOOKS:

1. Fundamentals of Physics, Halliday, Walker and Resnick

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination	25
End Sem Examination	50
Quiz	20
Teacher's assessment / Assignment	05

Continuous Internal Assessment	% Distribution
Mid Sem Examination	50
Quiz	40
Teacher's assessment / Assignment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Self- learning such as use of NPTEL materials and internets
CD4	
CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO 1	**M**	**M**		**L**	**L**				**M**	**L**		**L**			
CO 2	**M**	**M**		**L**	**L**				**M**	**L**		**L**			
CO 3	**M**	**L**		**L**	**L**				**M**	**L**		**L**			
CO 4	**M**	**L**		**L**	**L**				**M**	**L**		**L**			
CO 5	**M**	**L**		**L**	**L**				**M**	**L**		**L**			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

COURSE INFORMATION SHEET

Course Code: PH24102
Course Title: Physics lab
Pre-requisite(s): Intermediate Physics
Co- requisite(s):
Credits: 1 L: 0 T: 0 P: 2
Class schedule per week: 2
Class: B.Tech.
Semester / Level: I
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course enables the students to:

1.	Understand the fundamentals of physical measurements and learn to account for inevitable errors in physical measurements.
2.	Understand and verify the basic principles of physics by hands-on experiments and making suitable measurements.
3.	Make electrical connections reliably to form functional circuits for measuring electrical quantities such as voltage, current, resistance, and resistivity
4.	Learn to set up different types of oscillating systems study their characteristics, viz -a-viz resonant frequency, frequency response, phase relationship, bandwidth, and quality factor
5.	Develop an understanding of optical phenomena like dispersion, interference and diffraction and make measurements on the patterns produced to obtain physical quantities such as wavelength of light and refractive index of transparent materials.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Make reliable measurements and report results along with errors.
CO2	Wire simple electrical circuits for experimentally determining measurable electrical quantities.
CO3	Build oscillating systems and make measurements over them.
CO4	Set up and customize simple second-order electrical circuits, characterize them, and gain knowledge about their applications such as electrical filters, and tank circuits.
CO5	Produce interference and diffraction patterns and make measurements for determining physical quantities.

SYLLABUS (List of experiments)

1. Error analysis in Physics Laboratory (CO: 1)
2. To determine the frequency of AC mains with the help of a sonometer. (CO:1, 2, 3)
3. To determine the resistance per unit length of a Carey Foster's bridge wire and resistivity of unknown wire. (CO:1, 2)
4. Measurement of electrical equivalent of heat (CO:1, 2)
5. To determine the wavelength of sodium lines by Newton's rings method (CO:1, 5)
6. To determine the frequency of tuning fork using Melde's Experiment (CO:1,3)
7. Measurement of voltage and frequency of a given signal using CRO (CO: 1,2, 3, 4)

8. To determine the emf of a cell using stretched wire potentiometer (CO:1, 2)
9. Determination of refractive index of the material of a prism using spectrometer and sodium light (CO:1, 5)
10. To study the frequency response of a series LCR circuit (CO:1, 2, 3,4)
11. To study Lorentz force using Current balance (CO:1,2)
12. To study electromagnetic induction and verification of Faraday's laws. (CO:1,2,3)
13. To measure the wavelength of prominent spectral lines of mercury light by a plane transmission grating. (CO:1, 5)
14. To determine the Planck's constant using photocell and optical wavelength filters. (CO:1, 2)

REFERENCE MATERIALS:

1. Lab manuals (available on department website)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Lab Journal	30
Lab quizes	20
Progressive viva	20
End Sem Examination	30

Continuous Internal Assessment	% Distribution
Lab Journal	30
Lab quiz	10
Progressive viva	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	Y
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Introductory lecture by use of boards/LCD projectors
CD2	Laboratory experiments/ teaching aid
CD3	Self- learning such as use of NPTEL materials and internets

CD4	
CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO 1	**M**	**M**		**L**	**L**				**M**	**L**		**L**			
CO 2	**M**	**M**		**L**	**L**				**M**	**L**		**L**			
CO 3	**M**	**L**		**L**	**L**				**M**	**L**		**L**			
CO 4	**M**	**L**		**L**	**L**				**M**	**L**		**L**			
CO 5	**M**	**L**		**L**	**L**				**M**	**L**		**L**			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

COURSE INFORMATION SHEET

Course Code: CS24101
Course Title: Programming for Problem Solving
Pre-requisite(s): Scholl level mathematics and Science
Co- requisite(s):
Credits: L: 3 T: 1 P:0
Class schedule per week: 4
Class: UG
Semester / Level: II
Branch: ALL
Name of Teacher: ?

COURSE OBJECTIVES

This course envisions to impart to students to:

	Develop Programming Skill.
	Understand the fundamental Concepts of Coding
	Learn how to Debug Programs
	Convert Problems to Programs

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Formulate Algorithms for arithmetic and logical problems.
CO2	Translate the algorithms to programs.
CO3	Test and execute the programs and correct syntax and logical errors.
CO4	Apply programmatic skills for solving scientific problems.
CO5	Decompose problems into functions and structured programming.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Representation of an Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs: source code, variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	**6**
Module – II Structure of a C program, variables and data types, Operators – precedence and associativity, Evaluating expressions, Basic I/O – use of printf, scanf, getchar etc. and format specifiers, Conditional Branching statements – If, If - else, If-else- if, switch case, Writing nested conditional statements.	**8**
Module – III Iterative programming structures – for loops, while loops, do while loops. Understanding break and continue and their usage. Writing Nested loops, Arrays – creation and usage, Strings and string handling.	**8**
Module – IV Functions (including using built in libraries), Parameter passing in functions, call by value, Recursion, as a different way of solving problems, Nested function calls. Understanding scope and lifetime of a variable.	**8**
Module – V Structures - Defining structures, Accessing structures elements, Creating an array of Structures, Nested structures. Some advanced concepts – typedef, enum, macros. An introduction to pointers – understanding, creating pointers and accessing variables using pointers. Passing arrays to functions: idea of call by reference, passing parameters to main.	**10**

TEXTBOOKS:

1. Let us C, Yashwant Kanetkar, 18th Edition, BPB Publications
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. R.G.Dromey, How to Solve it by Computer, Pearson Education

REFERENCE BOOKS:

• Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

7. The syllabus focused on the concepts and basics of Program writing skills.
8. Industry often requires debugging of their existing programs/software compare to the new program, which is a knowledge beyond the basics, including real-world software (collection of programs) experience.
9. More memory management practices, file handling and library functions

POS MET THROUGH GAPS IN THE SYLLABUS: YES [PO1-PO5 & PO10-PO12]

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

File Handling with memory management, pre processor directives, Graphics, Data Arrangement, Task scheduling and assembly level programs.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: YES [PO1-PO5]

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Paper based Exam	85
Computer based Exam	15

Continuous Internal Assessment	% Distribution
Quiz-I	10
Assessment	10
Assignment	05
Mid-Semester	25

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**
- **Student Feedback on Faculty/Content Delivery**
- **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self-Learning, Group Study, Coding Contest

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO 2	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO 3	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**2**
CO 5	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5, CD7
CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course Code: CS24102
Course Title: Programming for Problem Solving Laboratory
Pre-requisite(s):
Co- requisite(s): Programming for Problem Solving (CS24101)
Credits: L: T: P:
Class schedule per week:
Class:
Semester / Level: Ist, 1
Branch:All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students:

	The basics of computer programming.
	Ideas about converting problem statements to programs.
	Ideas about handling data at scale.
	Knowledge about accessing the memory of a computer using code.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	**Write basic programs using fundamental control structures.**
CO2	**Demonstrate the accessing of arrays.**
CO3	**Write simple functions to modularize programs.**
CO4	**Work with user defined data types.**
CO5	**Access memory using pointers and manipulate data using them.**

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Programming using basic control structures including sequential programs, selection logic including nested selection logic switch structures.**	**3**
Module – II **Write programs using basic iterative structures, nested iterations, programs using looping with selections, controlled loop exit, Manipulating n-dimensional arrays.**	**3**
Module – III **Modularize programs using functions, functions calling functions, elementary string handling programs, recursive programs.**	**3**
Module – IV **Programs using user defined data types, arrays of user defined data types, basic usage of pointers, functions and pointers.**	**3**
Module – V **Advanced usage of pointers, string handling using pointers, parameterizing main, manipulating arrays using pointers.**	**3**

TEXTBOOKS:

1) Programming in C, Yashwant Kanetkar, BPB Publications.

REFERENCE BOOKS:

1) C Programming, Byron Gottfried, Addison Wesley Press

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

1) Elementary file handling

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment

Laboratory Quiz	20
Laboratory Performance	30
Laboratory Viva	20
Continuous Evaluation	30

Continuous Internal Assessment	% Distribution
Labor	

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self- learning such as use of NPTEL materials and internets

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2				3	1			3	3	
CO2	3	3	2	1	2				3	1			3	2	
CO3	3	3	2	1	2				3	1			3	2	
CO4	3	3	2	1	2				3				3	2	
CO5	3	2	2	1	2				1				3		

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course code: EE24101
Course Title: Basics of Electrical Engineering
Pre-requisite(s): Basic Sciences
Co-requisite(s):
Credits: L: 2 T: 1 P:
Class schedule per week: 03
Class: B. Tech.
Semester / Level: I/ 01
Branch: All
Name of Teacher:

Course Objectives

This course enables the students to:

A. realize the electrical signals, elements, and their properties.

B. understand the mathematical representation of AC, DC signals and theorems/laws for solving electrical circuits with variations of voltage and frequency.

C. perceive the 3-phase AC signal representation and 3-phase circuit analysis for balanced and unbalanced condition.

D. understand the characteristics of magnetic material and analysis of magnetic circuits.

Course Outcomes

After the completion of this course, students will be able to:

1. explain the voltage, current signals and their characteristics in electrical circuit elements.
2. apply the theorems/laws for electrical circuit analysis.
3. solve the electrical circuits for variable voltage and frequency to observe the resonance, power and power factor in the electric circuit.
4. analyze the 1-phase and 3-phase AC balanced and unbalanced circuits
5. apply the concept of magnetic circuits for magnetic circuit analysis.

EE24101 Basics of Electrical Engineering

SYLLABUS

MODULE – I

Introduction: Importance of Electrical Engineering in day-to-day life, Electrical elements, properties (linear, non-linear, unilateral, bilateral, lumped and distributed, etc.) and their classification, Ideal and Real Sources, Source Conversion, Star-Delta conversion, KCL and KVL, Mesh current and Nodal voltage method. (8)

MODULE – II

D.C. Circuits: Steady state analysis with independent and dependent sources; Series and Parallel circuits.

Circuit Theorems: Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems for Independent and Dependent Sources applied to DC circuits. (8)

MODULE – III

Single-phase AC Circuits: Common signals and their waveforms, RMS and Average value. Form factor & Peak factor of a sinusoidal waveform. **Series Circuits:** Impedance of Series circuits. Phasor diagram. Active Power. Power factor. Power triangle. **Parallel Circuits:** Admittance method, Phasor diagram, Power and Power factor Power triangle, Series-parallel Circuit, Power factor improvement, Circuit Theorems applied to AC circuits.

Series and Parallel Resonance: Resonance curve, Q–factor, Dynamic Impedance, and Bandwidth. (12)

MODULE – IV

Three-Phase AC Circuits: Importance and use of a 3-phase network, types of 3-phase connections- Star and Delta, Line and Phase relations for Star and Delta connection, Phasor diagrams, Power relations, analysis of balanced and unbalanced 3-phase circuits, Measurement of Power in 3-phase star and delta network. (6)

MODULE – V

Magnetic Circuits: Introduction, Series-parallel magnetic circuits, Analysis of Linear and Non-linear magnetic circuits, Energy storage, A.C. excitation, Eddy currents and Hysteresis losses.

Coupled Circuits: Dot rule, Self and mutual inductances, Coefficient of coupling, working of transformer. (6)

Textbooks:

1. W. H. Hayt, Jr J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 7th Edition TMH, 2010.
2. Hughes, Electrical Technology, Revised by McKenzie Smith, Pearson.
3. Fitzgerald and Higginbotham, Basic Electrical Engineering, McGraw Hill Inc, 1981.

Reference books:

1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, 3rd Edition, TMH, New Delhi, 2009.
2. Electrical Engineering Fundamental, Vincent Del Toro, Prentice Hall, New Delhi.
3. Rajendra Prasad, Fundamentals of Electrical Engineering, 2nd Edition, PHI, New Delhi, 2011.
4. Raymond A. DeCarlo, Prn-Min Lin, Linear Circuit Analysis Time Domain, Phasor and Laplace Transform Approaches, 2nd Edition, Oxford University, 2001
5. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, Basic Electrical Engineering, Tata McGraw Hill Publication, 2009.

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors.
2. Field applications of three phase equipment and circuits in power system.
3. Applications of circuit theorems in electrical and electronics engineering.

POs met through Gaps in the Syllabus: 3, 4, 12.

Topics beyond syllabus/Advanced topics/Design

1. Concepts of electric, magnetic and electromagnetic fields.
2. 3 - Φ power generation, transmission, and distribution.
3. Power factor improvement for three phase systems.
4. Utility of reactive power for creation of electric and magnetic fields.

POs met through Topics beyond syllabus/Advanced topics/Design: 2, 3, 4, 12.

Course Delivery methods

Lecture by use of boards/LCD projectors/OHP projectors
Tutorials/Assignments
Seminars
Mini projects/Projects
Laboratory experiments/teaching aids
Industrial/guest lectures
Self- learning such as use of NPTEL materials and internets
Simulation

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Quiz (s)	10
End Semester Examination	50
Mid Semester Examination	25
Assignment	10
Teacher Assessment	05

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Quiz					
Mid Semester Examination					
Assignment					
End Semester Examination					

Teacher Assessment						

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (PO)												Program specific outcome (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	1		1	1				1			2	1	
CO2	3	3	3	1	2	1				1			3	3	
CO3	3	3	3	2	2	1	1			1		1	3	3	
CO4	3	3	3	2	2	1				1			3	3	
CO5	3	3	3	2	2	1				1			3	3	

3= High, 2=Medium, 1=Low

COURSE INFORMATION SHEET

Course code: EE24102

Course title: Electrical Engineering Laboratory

Pre-requisite(s): Physics, Fundamentals of Mathematics and Electrical Engineering.

Credits: L:0 T:0 P:2 C:1

Class schedule per week: 2

Course Overview: Concepts of measuring instruments, AC RLC series parallel circuit operation, resonance, KVL and KCL, circuit theorems, 3-phase star and delta connections, measurement of low and high resistance of D.C. machine, measurement of power by three voltmeter, three-ammeter methods, measurement of power of 3-phase by two-wattmeter method.

Course Objectives

This course enables the students:

1.	To describe students' practical knowledge of active and passive elements and operation of measuring instruments
2.	To demonstrate electrical circuit fundamentals and their equivalent circuit models for both 1-φ and 3- φ circuits and use circuit theorems
3.	To establish voltage & current relationships with the help of phasors and correlate them to experimental results
4.	1. To conclude performance of 1 – Φ AC series circuits by resonance phenomena 2. To evaluate different power measurement for both 1-φ and 3- φ circuits

Course Outcomes

After the completion of this course, students will be able to:

CO1	classify active and passive elements, explain working and use of electrical components, different types of measuring instruments;
CO2	illustrate fundamentals of operation of DC circuits, 1-φ and 3- φ circuits and also correlate the principles of DC, AC 1-φ and 3- φ circuits to rotating machines like Induction motor and D.C machine
CO3	measure voltage, current, power, for DC and AC circuits and also represent them in phasor notations;
CO4	analyze response of a circuit and calculate unknown circuit parameters;
CO5	recommend and justify power factor improvement method in order to save electrical

LIST OF EXPERIMENTS ***(The experiment list may vary to accommodate recent development in the field)***

1. **Name:** Measurement of low & high resistance of DC shunt motor

   Aim:

   (i) To measure low resistance of armature winding of DC shunt motor

   (ii) To measure high resistance of shunt field winding of DC shunt motor

2. **Name:** AC series circuit

   Aim:

   (i) To obtain current & voltage distribution in AC RLC series circuit and to draw the phasor diagram

   (ii) To obtain power & power factor of single-phase load using 3- Voltmeter method and to draw phasor diagram.

3. **Name:** AC parallel circuit

   Aim:

   (i) To obtain current & voltage distribution in AC RLC parallel circuit and to draw the phasor diagram

   (ii) To obtain power & power factor of single-phase load using 3- Ammeter method and to draw the phasor diagram

4. **Name:** Resonance in AC RLC series circuit

   Aim:

   (i) To obtain the condition of resonance in AC RLC series circuit

   (ii) To draw phasor diagram

5. **Name:** 3-phase Star connection

   Aim:

   (i) To establish the relation between line & phase quantity in 3 phase star connection

   (ii) To draw the phasor diagram

6. **Name:** 3-phase Delta connection

   Aim:

(i) To establish the relation between line & phase quantity in 3 phase delta connection

(ii) To draw phasor diagram

7. **Name:** 3-phase power measurement

   Aim:

   (i) To measure the power input to a 3-phase induction motor using 2 wattmeter method

   (ii) To draw the phasor diagram

8. **Name:** Self & mutual inductance

   Aim: To determine self & mutual inductance of coils

9. **Name:** Verification of Superposition, Thevenin's and the Reciprocity theorem

   Aim:

   (i) To verify the Superposition theorem for a given circuit

   (ii) To verify Thevenin's theorem for a given circuit

10. **Name:** Verification of Norton's, Tellegen's and Maximum Power transfer theorem

    Aim:

    (i) To verify Norton's theorem for a given circuit

    (ii) To verify the Maximum Power transfer theorem for a given circuit

Gaps in the syllabus (to meet Industry/Profession requirements)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors
2. Visualize Phase sequence

POs met through Gaps in the Syllabus: 1, 2, 3, 7.

Topics beyond syllabus/Advanced topics/Design

1. Assignment: Simulation of electrical circuits with dependent/independent sources by various techniques (Mesh current/Node Voltage/Thevenin's theorem/Norton's theorem/Maximum power transfer theorem etc.) using MATLAB/PSIM/C++ softwares.
2. Active/reactive power calculation for 3 – Φ circuits

POs met through Topics beyond syllabus/Advanced topics/Design: 5, 6, 7, 8, 9.

Mapping of lab experiment with Course Outcomes

Experiment	Course Outcomes				
	CO1	CO2	CO3	CO4	CO5
1	3	3	3	2	
2	3	3	3	3	2
3	3	3	3	3	2
4	3	3	3	3	2
5	3	3	3	1	
6	3	3	3	1	
7	3	3	3	2	2
8	3	3	3	3	
9	3	3	3	2	
10	3	3	3	2	

CO mapping with PO

Course Outcome	Program Outcomes												Program Specific Outcome		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	3	3	1	3	1	1	1				2	3	3	1
CO2	3	3	3	1	3	1	1	1				2	3	2	2
CO3	3	3	3	3	3	1	2	2		1	1	2	3	3	2
CO4	3	3	3	1	3	1	1	1		1	1	2	3	2	2
CO5	3	3	3	3	3	1	1	1	1	1	1	2	3	3	1

Course Delivery methods	
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Mini projects/Projects
CD4	Laboratory experiments/teaching aids
CD5	Self- learning, such as the use of NPTEL materials and the internet
CD6	Simulation

COURSE INFORMATION SHEET

Course Code: CS24201
Course Title: Data Structure and Algorithms
Pre-requisite(s): CS24101 Programming for Problem Solving
Co- requisite(s): MA24205 Discrete Mathematics
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class:
Semester / Level: III
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To be familiar with basic data structures and algorithm analysis.
	To understand basic concepts about arrays, linked lists .
	To understand basic concepts about stack, queue.
	To analyze concepts of searching and sorting techniques.
	To understand concepts of non-linear data structures.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Be conversant with basic data structures and algorithm analysis.
CO2	Be able to apply the concepts of arrays, linked lists .
CO3	Be able to apply stack and queue data structures in solving problems.
CO4	Be able to analyze searching and sorting algorithms.
CO5	Be able to use non-linear data structures in solving problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Basics of Data Structures and Algorithm, Time and Space Complexity, Asymptotic Notations, Time complexity analysis of non-recursive and recursive algorithms, Examples of multi-dimensional array, polynomial operations and sparse matrix**	**5**
Module – II **Singly Linked List: concept, representation and operations, Circular Linked List, Doubly Linked List, Multi-ply linked list and their Applications**	**8**
Module – III **Stack: basic operations using Array and LL, Queue: basic operations using Array and LL, Circular Queue and Variants of Queue, Stack and Queue**	**10**

Applications	
Module – IV **Binary Search, Hash Search, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Radix Sort, External Sorting: k-way merging approach, Analysis of Search and Sorting Algorithms**	**7**
Module – V **Basic concepts and terminologies of Binary Search Tree, Height Balanced Trees and Heap, Disjoint Set, Graph: concept and terminologies, Concept of Breadth First Search, Depth First Search, Spanning Tree.**	**10**

TEXTBOOKS:
Sahni Horwitz,, Freed Anderson, Fundamentals of Data Structures in C, 2 nd Edition (or latest) , University Press.(T1)

REFERENCE BOOKS:
1. Thareja Reema, Data Structures Using C, 2nd Edition, Oxford University Press.(R1)
2. Tanenbaum, Langsam, Augenstein, Data Structures using C, Pearson. (R2)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Quiz1 & Quiz2/Assignment/Seminar Presentation	20
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT
11. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self-Learning, Group Study, Coding Contest

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO 1	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO 2	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO 3	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO 4	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**2**
CO 5	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5, CD7
CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course Code: CS24202
Course Title: Data Structure and Algorithms Lab
Pre-requisite(s): CS24101 Programming for Problem Solving
Co- requisite(s): CS24201 Data Structure and Algorithms
Credits: L: 0 T: 0 P: 3
Class schedule per week:
Class:
Semester / Level: III
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To learn and implement concepts of class and object in C++
	To use concepts of arrays and linked list in programs
	To use concepts of stack and queue in programs
	To implement searching and sorting techniques in providing solutions
	To use and implement Tree and Graph data structures in solving problems

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Be able to program in C++ using classes and objects.
CO2	Be able to write programs implementing concepts of arrays and linked lists.
CO3	Be able to write programs implementing concepts of stack and queues using array and linked list.
CO4	Be able to write programs using various searching and sorting techniques
CO5	Be able to implement concepts of tree and graph data structures in programs.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Understanding and implementation of class and object concepts in C++**	**2**
Module – II **Use the concepts of single and multi-dimensional arrays and circular, doubly, multiply linked lists in programs.**	**3**
Module – III **Implement operations of stack and basic queue, circular queue, and other variants of queue using Array and Linked List**	**3**
	3

Module – IV **Implement the concepts of searching and sorting techniques in solving problems.**	
Module – V **Use and implement the concepts of Binary Search Tree, Height Balanced Trees and Heap, Disjoint Set, Graph, BFS, DFS in solving problems.**	**3**

TEXTBOOKS:

1. Baluja G S, "Data Structure through C", Ganpat Rai Publication, New Delhi, 2015.
2. Pai G A V, "Data Structures and Algorithms: Concepts, Techniques and Applications", 2ndEdn, Tata McGraw-Hill, 2008.
3. Horowitz E., Sahni S., Susan A., "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2010.

REFERENCE BOOKS:

1. Tremblay J. P., Sorenson P. G, "An Introduction to Data Structures with Applications", 2nd Edn, McGraw-Hill, Inc. New York, NY, USA.
2. Lipschutz Seymour, "Data Structures", 6th Edn, 9th Reprint 2008, Tata McGraw-Hill
3. Drozdek Adam, "Data Structures and Algorithms in C++", Thomson Learning, New Delhi – 2007.
4. Feller J., Fitzgerald B., "Understanding Open Source Software Development", Pearson Education Ltd. New Delhi

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to day performance and Lab file	30
Quizes	10
Viva	20

Semester End Exam	% Distribution
Examination/Experiment/Performance	30
Quize	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

12. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO 1	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**1**	**2**	**1**	**1**	**2**	**3**	**2**
CO 2	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**2**	**1**	**1**	**2**	**2**	**3**	**2**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**1**	**2**	**1**	**2**	**3**	**3**	**2**
CO 4	**3**	**3**	**3**	**3**	**2**	**2**	**0**	**0**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO 5	**3**	**2**	**2**	**1**	**2**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: CS24205
Course Title: Computer Organization and Architecture
Pre-requisite(s):
Co- requisite(s): EC24203 Digital System Design
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class:
Semester / Level: III
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To understand the basic architecture and organization of systems along with their performances.
	To Familiar with Data representation, Computer arithmetic, Instruction Set Architecture and execution through Datapath.
	To design CPU and understand the pipeline concepts and Hazards.
	To explore Memory Organization and its impact.
	To deal with I/O environment and Parallel Processing paradigm

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Explain the basic building blocks and architectural view of Computers with performance issues
CO2	Examine the grain level view of instruction execution and instruction sequencing
CO3	Design of ALU,Generate operation wise control signals and speed up using Pipelining
CO4	Evaluate the impact of different Memory organization
CO5	Analyze and improve the performance through I/O operation and parallel processing concepts

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I (Basic Structures of Computers) Digital Logic Concepts Revisit: Combinational Circuits, Sequential Circuits, Flip-Flops, Registers, Fixed and floating point Representation and Arithmetic Operations Basic Structure of Computers: Computer Types, Functional Units, Input Unit, Memory Unit, Arithmetic and Logic Unit, Output Unit, Control Unit, Performance, Evolution of Computer Architecture	**8**
Module – II (Instruction Set Architecture and Data Path)	**8**

Instruction Set Architecture : Memory Locations and Addresses, Byte Addressability, Big-Endian and Little-Endian Representation, Word Alignment, Addressing Modes, Assembly Language, Subroutines. Datapath: Instructions and Instruction Sequencing, Bus Concepts: Address Bus, Data Bus and Control Bus	
Module – III (Basic Processing Unit & Pipelining) Basic Processing & Control Unit: ALU Design Concepts, Instruction Execution, Instruction Fetch and Execution Steps. Control Signals, Hardwired Control, Microprogram Control. Pipelining: Basic Concept, Pipeline Organization, Pipelining Issues, Data Dependencies, Memory Delays, Branch Delays, Pipeline Performance Evaluation.	**8**
Module – IV (Memory Organization) Basic Memory Organization: Memory Hierarchy, Semiconductor RAM Memories, Read-only Memories Cache and Other Memory Organization: Cache Memories, Performance Considerations, Virtual Memory, Technology related to Hard Disk and RAID.	**8**
Module – V(Input Output & Parallel Processing) Basic Input Output: Accessing I/O Devices, Interrupts, Direct Memory Access, Bus Arbitration. Parallel Processing: Hardware Multithreading, Vector (SIMD) Processing, Shared-Memory Multiprocessors, Cache Coherence, Multicomputers, Performance Modeling.	**8**

TEXTBOOKS:
Patterson David A., Hennessy John L., Computer Organization and Design: The Hardware / Software Interface, 5th Edition, Elsevier.(T1)

REFERENCE BOOKS:
1. Hamachar Carl et. al , Computer Organization and Embedded Systems, 6 th Edition, McGraw Hill. (R1)
2. Mano M. Morris, Computer System Architecture, Revised 3 rd Edition, Pearson.(R2)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Quiz1 & Quiz2/Assignment/Seminar Presentation	20
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

13. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self-Learning, Group Study, Coding Contest

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	2	2	1	2	2	3	3	3
CO2	3	3	3	3	3	1	1	2	2	1	2	2	3	3	2
CO3	3	3	3	3	3	1	1	2	2	1	2	2	3	3	2
CO4	3	3	3	3	3	1	1	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	1	1	2	3	1	3	3	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3

CO2	CD3, CD5
CO3	CD3, CD5, CD7
CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course Code: AI24201
Course Title: Mathematics for AIML
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the concepts of Linear Algebra
	Prepare Language Models
	Use of Probability & Statistics
	Model the ML Algorithms using Optimization

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Apply the concepts of Linear Algebra
CO2	Create Language Models using Mathematical Foundations
CO3	Optimize errors in the Machine Models using statistical foundations
CO4	Provide Synthetic Data sets for Model Testing
CO5	Design, Plan and manage AI and ML Complex Problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Set and Relation, Functions and Logic, Functions: Introduction, Types of Functions, Growth of Functions, Polynomials, Operations on Polynomials. Graph Theory: Introduction, Graph representations (Matrix, List)	**8**
Module – II Probability Distributions: Basics, different types of distributions (Example: Normal, Chi-square, etc.), Basics of Statistics, Statistical Theory of Machine Learning, Classification, Regression, Aggregation, Empirical Risk Minimization,	**8**

Regularization, Hypothesis Testing, Bayesian methods, Markov Chain, Hidden Markov Model.	
Module – III Linear Algebra and Matrices Vector Spaces and Matrices: Field, Vector and Vector Space (Linear Dependence and Independence, Basis Vectors and Dimension), EigenValue and Eigenvector, Matrix Factorization using Eigenvalue and Eigen-Space, Eigen Value Decomposition, Hilbert Space, Orthogonality, Norms, Jacobian and Hessian Matrix.	**8**
Module – IV Singular Value Decomposition, Linear Discriminant Analysis, and Principal Component Analysis Introduction to Matrix Calculus: Matrix Differentiation, Matrix Integration. Chebyshev Interpolation, Hermit Regression, Lagrange Interpolation, Least Square Regression.	**8**
Module – V Gradient Descent Methods for Optimization, Algorithms and Convexity, Boosting, Kernel Methods, Convex Optimization, Bandit Problems, Stochastic Gradient Method, Introduction to Non Linear Optimization: Maximum Likelihood estimation. Metrics: Accuracy, Precision, Recall, F1-score, AUC-ROC. Basic concepts of dataset. K-fold cross-validation, Other cross-validation techniques, Validation set, Model interpretability and explainability	**8**

TEXTBOOKS:

- Arangala C., "Linear Algebra with Machine Learning and Data", CRC Press, 1st Edition, 2023

REFERENCE BOOKS:

- Carter N. "Data Science for Mathematicians", CRC Press, 1st Edition, 2021
- Strang G. "Introduction to Linear Algebra", 5th Edition, Cambridge Press, 2016

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Paper based Exam	85
Computer based Exam	15

Continuous Internal Assessment	% Distribution
Quiz-I	10
Assessment	10
Assignment	05
Mid-Semester	25

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome
2. Student Feedback on Faculty/Content Delivery
3. Student Feedback on Evaluation Procedures

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self-Learning, Group Study, Coding Contest

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5, CD7

CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course Code: AI24202
Course Title: Mathematics for AIML LAB
Pre-requisite(s):
Co- requisite(s):
Credits: L: 0 T: 1 P: 3
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To convert the Concepts of Mathematics into Programming Language
	To apply the Statistical theory in Machine learning Framework
	To convert real world problems Mathematical Models
	To observe the behaviour Machine for different Data Input

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Able to Apply Programming Languages for ML
CO2	Able to Create Machine Models through different Mathematical and Statistical Techniques
CO3	Able to visualize the concepts of Stochastic Process for ML
CO4	Able to Test and validate ML models
CO5	Able to develop ML pipelines

SYLLABUS

MODULE	(NO. OF LABS)
Module – I **Programs based on Linear Algebra Theory using Python**	**3**
Module – II **Programs based on Language Theory and its Grammars**	**2**
Module – III **Programs based on Statistical and Mathematical Model**	**3**

Module – IV **Programs based on the concepts of Model Optimization**	**2**
Module – V **Programs based on ML Frameworks using Tensor flow, Py torch**	**3**

TEXTBOOKS:

- **The complete reference book for Python by Martin C Brown, TMH Publisher, 2018**
- **Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, by Aurélien Geron Third Edition, 2022**

REFERENCE BOOKS:

1. **https://www.tensorflow.org/**
2. **https://github.com/**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

4. Student Feedback on Course Outcome
5. Student Feedback on Faculty/Content Delivery
6. Student Feedback on Evaluation Procedures

COURSE DELIVERY METHODS

CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**1**	**2**	**1**	**1**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**2**	**1**	**1**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**1**	**2**	**1**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**0**	**0**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO5	**3**	**2**	**2**	**1**	**2**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

RANCHI

COURSE INFORMATION SHEET

Course Code: MA24205
Course Title: Discrete Mathematics
Pre-requisite(s): -
Co- requisite(s): --
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3 L
Class: B.Tech.
Semester / Level: III/2
Branch: CSE, AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	provide foundational understanding of mathematical logic, its principles, and its applications in mathematics and computer science to develop critical thinking, reasoning skills, and the ability to construct and analyze logical arguments.
	equip students with the knowledge and techniques to formulate, solve, and analyze recurrence relations
	understand and apply set theory in different mathematical and computational contexts
	develop an understanding of algebraic structures, including groups, semigroups, and permutation groups, and explore their role in coding, decoding, and error correction techniques.
	apply graph theory-based tools in solving practical problems.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	model and analyze computational processes using analytic and combinatorial methods
CO2	solve the problems of recurrence relations
CO3	understand the concepts of set, relations, growth of function and their applications for computer science.
CO4	apply the knowledge of algebraic structures for coding and decoding of binary information.
CO5	apply graph theory in the areas of computer science and engineering

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module I Mathematical logic and Mathematical Reasoning, Compound Statements, Propositional Equivalences, Predicates and Quantifiers, Methods of Proof, Mathematical Induction.	**8**
Module II Recurrence Relations, Classification of Recurrence Relations and their solutions by	**8**

Characteristic Root method, Generating function and their various aspects, Utility of Generating function in solving Recurrence Relations**.**	
Module III Set, Operations on Set, Relations, Properties/Classification of Relations, Closure operations on Relations, Matrix representation of Relations, Digraphs, Partial Ordering, Poset, Warshall's algorithm, Growth of Functions, Big O, Big Omega, Big Theta.	**8**
Module IV Binary Operations, Groups, Product of Groups, Semi group, Permutation Group, Composition of Permutation, Inverse Permutation, Cyclic Permutation, Transposition, Even and Odd Permutation, Coding of Binary Information and Error Correction, Decoding and Error Correction.	**8**
Module– V: Introduction to Graph, Graph Terminologies and their Representation, Connected & Disconnected graphs, Isomorphic Graph, Euler & Hamilton graphs. Introduction to Trees, Spanning Trees, Minimum Spanning Tree.	**8**

TEXTBOOKS:

1. Mott, Joe L., Abraham Kandel, and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, PHI, 2nd edition, 2002.
2. Swapan Kumar Chakraborty and Bikash Kanti Sarkar: Discrete Mathematics, Oxford Univ. Publication, 2010.
3. Kolman, Bernard, Robert C. Busby, and Sharon Ross. Discrete mathematical Structures, Prentice-Hall, Inc., 2003.

REFERENCE BOOKS:

1. Bikash Kanti Sarkar and Swapan Kumar Chakraborty, Combinatorics and Graph Theory, PHI, 2016.
2. A. Tucker, Applied Combinatorics**,** Wiley, Sixth Edition
3. Leymour Lipschutz and Mark Lipson, Discrete Mathematics, Shaum's outlines, 2003.
4. Liu, Chung Laung, Elements of Discrete mathematics, Mcgraw Hill, 2nd edition, 2001.
5. Bondy and Murty, Graph Theory with Applications, American Elsevier,1979.
6. Robin J. Wilson, Introduction to Graph Theory, Pearson, 2010.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN –

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	√
CD 7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO 1	3	3	2	2	2	0	0	0	1	1	1	2			
CO 2	3	3	2	2	2	0	0	0	0	1	1	2			
CO 3	3	2	2	1	2	0	0	0	0	1	1	2			
CO 4	3	2	2	2	3	0	0	1	1	1	2	2			
CO 5	3	3	2	2	3	0	1	1	1	2	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6
CO5	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course Code: CS24211
Course Title: Database Management System
Pre-requisite(s): CS2401 Data Structures and Algorithms
Co- requisite(s): CS24212 Database Management System Lab
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3 L
Class: B.Tech**.**
Semester / Level: IV/2
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To recognize the basic ideas, contemporary patterns, and the structures, functions, and operations of the various database components.
	To understand the core concepts of database design and efficient retrieval of data from a database.
	To have a concrete understanding of the data structures and algorithms required for the implementation of the databases.
	To understand the fundamental concepts of query optimization, transaction management and data loss prevention and recovery.
	To have a clear understanding of the issues related to the concurrency control in databases and effective resolution mechanisms.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Communicate a clear understanding of the core concepts of a relational database and its components.
CO2	Design precise ER diagrams and convert them to relational schema.
CO3	Formulate queries in abstract forms and demonstrate commands over SQL.
CO4	Justify the core design principles of RDBMS and the choice of data structures thereof.
CO5	Demonstrate the ability to perform transaction management and concurrency control.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Database and Entity-Relationship Model Database System Applications, File System Vs Database Systems, View of Data, Database Languages, Transaction Management, Database architecture, Database Users and Administrator, Types of database System, Overview of design process. E-R model, Constraints, E–R Diagram and its components, E-R Diagram issues, Weak Entity Sets, Extended E-R Features, Reduction to E-R Schemas to Tables.	**6**
Module – II Relational Model	

Structure of Relational Database, Codd's Rules, Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. Basic structure of SQL queries, Set Operations, Aggregate Functions, Null Values, Nested Sub Queries, Complex Queries, views, Modification of Database, Joined relations, Data Definition Language, SQL Data Types & Schema Definition, Integrity Constraints, Authorization, Triggers.	**10**
Module – III Relational Database Design Issues in Designing Relational Databases, Types of Anomalies, Normalization and its Types, First normal form, Closure of a Set, Functional dependency, Finding Candidate keys, Decomposition, Second normal form, Third normal form, BCNF, Multivalued dependencies and Fourth normal form, Fifth Normal form.	**8**
Module – IV Indexing, Hashing and Query Processing Ordered Indices, B+ Tree index files, B-Tree index files, Multiple key access Static hashing, Dynamic Hashing. Measure of Query Cost, Selection Operation, Evaluation of Expressions.	**8**
Module – V Transaction and Concurrency Control Transaction Concepts & ACID Properties, Transaction States, Implementation of Atomicity & Durability, Concurrent Executions, Serializability & Its Testing, Recoverability, Lock-Based protocols, Deadlock Handling.	**8**

TEXTBOOKS:

A. Silberschatz, H. F. Korth, S. Sudarshan. Database System Concepts, 7th Edition, McGraw Hill Education (India), 2021.

REFERENCE BOOKS:

1. E. Ramez, N. Shamkant, Fundamentals of Database System, 7th Edition, Pearson Education, 2017
2. J. Gehrke, R. Ramakrishnan, Data Management System, 3rd Edition, McGraw Hill Higher Education, 2002
3. J. D. Ullman First Course in Database Systems, 3rd Edition, Pearson Education India, 2014

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50

End Semester Examination	50

Continuous Internal Assessment	**% Distribution**
Mid Semester Examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**0**	**2**	**0**	**2**	**0**	**1**	**1**	**1**	**1**	**1**	**2**	**3**	**2**	**2**
CO2	**3**	**1**	**2**	**1**	**3**	**0**	**2**	**1**	**1**	**1**	**3**	**2**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**0**	**2**	**1**	**1**	**2**	**3**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**0**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**3**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD3, CD5, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD6, CD7

COURSE INFORMATION SHEET

Course Code: CS24212
Course Title: Database Management System Lab
Pre-requisite(s): CS2401 Data Structures and Algorithms
Co- requisite(s): CS24211 Database Management System
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B.Tech.
Semester / Level: IV/2
Branch: Computer Science and Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To learn the concepts of database modeling using Entity-Relationship diagrams and practical implementation of designing databases.
	To understand and implement DDL and DML commands.
	To implement PL/SQL, CURSORS, Exceptions, Composite Data types.
	To execute stored procedures, functions and database Triggers.
	To write Embedded queries and develop database applications.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Design ER diagram of a production level database and conversion of the schemas into tables.
CO2	Demonstrate real life databases with appropriate relations, constraints, and domain values.
CO3	Demonstrate efficient retrieval of data from single or multiple tables and views.
CO4	Understand and execute advanced queries and procedures such as trigger, PL/SQL.
CO5	To design and implement real life database applications and use as embedded SQL.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Design and Implementation of ER diagram Use database administration software or their FOSS alternatives to create ER diagrams.	**2**
Module – II Implementation of DDL and DML Use SQL for creating databases, Tables, Fields, Relationships, key and domain constraints, insertion of data, alter table commands etc.	**2**
Module – III Implementation of Extended Query Language Use SQL for simple and advanced querying of databases including where clause, field and aggregate functions, nested queries, group by operations, joins, materialized and non-materialized view creation etc.	**3**

Module – IV Designing Triggers, PL/SQL Blocks Use SQL to create indexes, triggers (on update, insert, delete), cursors, PL/SQL blocks.	**3**
Module – V Implementation of Admin Tasks and Embedded Queries Perform other database administrative tasks like user management including grant, revoke, transaction management (COMMIT, SAVEPOINT, ROLLBACK, BEGIN and END transaction), application of embedded queries.	**2**

TEXTBOOKS:

S. Asnani, Oracle Database 12c hands-on SQL and PL/SQL, 2nd Edition, PHI Learning, 2015

REFERENCE BOOKS:

B. Bryla, K. Loney, Oracle Database 12c The Complete Reference, Oracle Press, 2013

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20
Semester End Examination	**% Distribution**
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Lab Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Seminars
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	1	1	1	0	2	2	0	3	3	2
CO2	3	3	3	3	3	1	1	1	0	0	2	0	3	3	1
CO3	3	3	3	3	3	1	1	1	0	0	2	0	3	3	1
CO4	3	3	3	3	3	1	1	1	0	0	2	0	3	3	1
CO5	3	3	3	2	3	2	1	1	2	2	2	2	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD2, CD3, CD4, CD5, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD6, CD7
CO4	CD1, CD2, CD3, CD4, CD5, CD6
CO5	CD1, CD2, CD3, CD4

RANCHI

COURSE INFORMATION SHEET

Course Code: CS24213
Course Title: Design and Analysis of Algorithms
Pre-requisite(s): Data Structures
Co- requisite(s): NA
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 03
Class: BTECH
Semester / Level: IV
Branch: CSE/AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the notion of algorithm & need and methods of the analysis of algorithm efficiency.
	Understand various algorithm design techniques.
	Use specific design paradigm(s) for solving a given problem.
	Find efficient ways to solve a given problem.
	Understand the limitations of algorithmic power.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Define the concepts and mathematical foundation for analysis of algorithms.
CO2	Explain different standard algorithm design techniques, namely Divide and conquer, Greedy, Dynamic Programming.
CO3	Demonstrate algorithms for solving fundamental problems in Computer Science.
CO4	Design algorithms for a given problem using standard algorithm design technique(s).
CO5	Explain and differentiate various complexity classes.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Algorithms and Complexity:** The role of algorithms in computing, algorithm complexity and various cases using Insertion Sort, growth of functions (asymptotic notations, standard notations and common functions), recurrences (the substitution method, the recursion – tree method and the master method).	**8**
Module – II **Divide and Conquer:**	**8**

Discussion of basic approach using Binary Search, Merge Sort, Quick Sort, Selection in Expected linear time, Maximum Subarray, Matrix Multiplication, Closest – Pair problem.	
Module – III **Greedy Approach:** The general method, Knapsack problem, Job Sequencing with Deadlines, Minimum – Cost Spanning Trees (Prim's Algorithm, Kruskal's Algorithm), Optimal Merge Patterns (Huffman Codes), Single Source Shortest Paths problem (Dijkstra's Algorithm).	**8**
Module – IV **Dynamic Programming:** The general method, 0/1 Knapsack problem, Travelling Salesperson Problem, Single Source Shortest Paths problem (Bellman-Ford Algorithm), All–Pairs Shortest Paths, Longest Common Sub-Sequence, Optimal BST.	**8**
Module – V **NP Completeness and other Related Topics:** NP Completeness and the classes P and NP, Overview of showing problems to be NP-Complete, (Decision and Optimization problems, Reductions), NP-Hard problems, NP Completeness proofs (Max-Clique, Vertex Cover), Introduction to Approximation Algorithms.	**8**

TEXTBOOKS:

- ***Introduction to Algorithms***
  by Thomas H. Cormen, Charles E. Leiserson, et al.
  PHI Learning Pvt. Ltd. (Originally MIT Press), Third / Latest Edition

REFERENCE BOOKS:

- ***Fundamentals of Computer Algorithms***
  by Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran
  Orient BlackSwan, Second / Latest Edition

- ***Introduction to the Design and Analysis of Algorithms***
  by Anany Levitin
  Pearson, Third / Latest Edition

- ***Fundamentals of Algorithmics***
  by Gilles Brassard and Paul Bratley
  Pearson, Latest Edition

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS): NA

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE: NA

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50

Continuous Internal Assessment	% Distribution
Assignment / Quiz (s)	10 + 10
Teacher's Assessment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of board / LCD Projector
CD2	Tutorials / Assignments
CD3	Seminars
CD4	Mini Project(s)
CD5	Expert Talks
CD6	Self-learning such as use of NPTEL materials and the Internet
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	0	0	1	0	1	3	3	3	2
CO2	3	3	3	3	3	1	0	0	1	0	1	3	3	3	2
CO3	3	3	3	3	3	1	0	0	1	0	1	3	3	3	2
CO	3	3	3	3	3	1	0	0	1	0	1	3	3	3	2

4															
CO 5	3	3	3	3	3	1	0	0	1	0	1	3	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	Lectures by use of board(s) / LCD Projector(s), Tutorial/Assignments
CO2	Lectures by use of board(s) / LCD Projector(s), Tutorial/Assignments
CO3	Lectures by use of board(s) / LCD Projector(s), Tutorial/Assignments
CO4	Lectures by use of board(s) / LCD Projector(s), Tutorial/Assignments
CO5	Lectures by use of board(s) / LCD Projector(s), Tutorial/Assignments

RANCHI

COURSE INFORMATION SHEET

Course Code: CS24215
Course Title: Operating System
Pre-requisite(s): Data Structure and Algorithms, Computer Organization & Architecture, PPS
Co- requisite(s): Shell and Kernel Programming
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B.Tech.
Semester / Level: 4
Branch: CSE/AI-ML
Name of Teacher: Amritanjali

COURSE OBJECTIVES

This course envisions to impart to students to:

	Appreciate the goals, functions, and fundamental features of operating systems
	Understand processes & threads management, synchronization, and deadlock handling
	Learn & analyze processor scheduling methods, memory management and virtual memory concepts
	Learn and analyze I/O management, file management, and disk scheduling methods

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Distinguish between different types of operating systems, and analyze their functions & use cases.
CO2	Handle issues related to concurrency, synchronization and deadlocks.
CO3	Evaluate and optimize CPU scheduling strategies.
CO4	Evaluate utilization of memory resources and take design decision to optimize usage.
CO5	Perform files system management and frame optimal disk storage and access policies

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Operating System** Introduction, Computer System Organization and Architecture, Operating System Operations, Resource Management, Security and Protection, Virtualization, Distributed System, Operating System Services, User and Operating System Interface	**8**
Module – II **Process Management** **Process and Threads**: Process Concept, Process Scheduling, Operations on Process, Interprocess Communication, Thread Overview, Multicore Programming, Multithreading Models.	**8**

CPU Scheduling: Basic Concepts, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multi-Processor Scheduling, Algorithm Evaluation	
Module – III **Process Synchronization and Deadlocks** **Process Synchronization**: Background, Critical Section Problem Peterson Solution, Hardware Support for Synchronization, Mutex locks, Semaphore, Monitors, Classical problems of Synchronization **Deadlock**: Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock	**8**
Module – IV **Main Memory**: Background, Contiguous Memory Allocation, Paging, Structure of the Page Table, Swapping, Segmentation **Virtual Memory**: Background, Demand paging, Copy-on-write, Page Replacement, Allocation of Frames, Thrashing	**8**
Module – V **Storage and File Management** **Storage Management**: HDD Scheduling, Swap Space Management, RAID Structures **File Management**: File Concepts, Access Methods, Directory structure, Protection, File- system Implementation, Allocation Methods and Free Space Management	**8**

TEXTBOOKS:

- Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 10th Edition, Wiley publication.

REFERENCE BOOKS:

3. Operating Systems: Internals and Design Principles, W. Stallins, 7th Edition, Pearson publication
4. Modern operating Systems, Andrew S. Tanenbaum, 5th Edition, Prentice Hall publication.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment

Continuous Internal Assessment	% Distribution

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of board / LCD Projector
CD2	Tutorials / Assignments
CD3	Seminars
CD4	Mini Project(s)
CD5	Expert Talks
CD6	Self-learning such as use of NPTEL materials and the Internet
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	2	2	1	2	2	2	3	3	2	2
CO2	3	3	3	3	2	2	2	1	2	2	2	3	3	3	2
CO3	3	3	3	3	2	2	2	1	2	2	2	3	3	3	2
CO4	3	3	3	3	3	2	2	1	2	2	2	3	3	3	2
CO5	3	3	3	3	3	2	2	1	2	2	2	3	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD3, CD5, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD6, CD7

COURSE INFORMATION SHEET

Course Code: AI24211
Course Title: Introduction to Artificial Intelligence
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 1 P: 0
Class schedule per week: 3
Class: B.Tech
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Apply knowledge of mathematics, science and engineering to both software and hardware design problems
2.	Design and conduct experiments and analyze and interpret data related to software and hardware design solutions
3.	Design a system, component or process to meet desired needs within realistic constraints.
4.	Function on multi-disciplinary teams using current computer engineering tools and technologies.
5.	Identify, formulate and solve engineering problems based on a fundamental understanding of concepts of computer engineering topics.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Analyze the principles and approaches of artificial intelligence and understand different aspects of Intelligent agent.
CO2	Apply different search techniques for solving real world problems and select the most appropriate solution by comparative evaluation.
CO3	Analyze the various concepts of knowledge representations and demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information
CO4	Develop a basic understanding of some of the more advanced topics of AI such as learning, natural language processing, Robotics etc.
CO5	Explain various types of LISP and PROLOG programs and explore more sophisticated LISP and PROLOG code

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction:** What is Artificial Intelligence (AI)? Evolution of AI, Intelligent Agents and its types, Concept of rationality, Nature of environments, Structure of agents: simple reflex agents, Model-based reflex agents, Goal Based Agents, Utility Based Agents, Learning Agents, Applications of AI	**6**
Module-II **Problem Solving and Search Techniques:** Problems, Problem Space & Search: Defining The Problem As State Space Search. **Uninformed Search Strategies**: Breadth First Search, Depth First Search, Uniform cost search, Iterative Deepening Algorithm (IDA). **Informed Search Strategies**: Greedy Best-First Search, A* search, heuristic functions, hill-climbing, Simulated Annealing Algorithm. **Adversarial search:** Minimax algorithm, Alpha-beta pruning. **Constraint Satisfaction Problems:** Cryptarithmetic Problem, graph colouring	**10**
Module – III **Knowledge & Reasoning**: Knowledge based agents, Knowledge representation in First Order Logic, Forward chaining, Backward chaining, Resolution, Matching, Overview of Semantic Networks	**8**
Module – IV **Planning and Probabilistic Reasoning:** **Planning**: Components of A Planning System, Goal Stack Planning, Hierarchical Planning. **Probabilistic Reasoning**: Representing Knowledge in an Uncertain Domain, Bayesian Networks, Dempster-Shafer Theory, Hidden Markov Models.	**8**

Module – V **Learning and Robotics**: **Learning**: Forms Of Learning, Inductive Learning, Explanation Based Learning. **Reinforcement Learning (RL)**: Passive RL, Active RL, Generalization in RL, Policy Search, Application of Reinforcement Learning. **Robotics**: Introduction, Robot hardware, robotic perception, planning to move, planning uncertain movements, robotic software architecture, application domains	**8**

TEXTBOOKS:

Russell S., Norvig P. "Artificial Intelligence: A Modern Approach", Pearson Publications, 4th Edition, 2022

REFERENCE BOOKS:

1. Ertel W.., "Introduction to Artificial Intelligence", UTiCS Springer, 2nd Edition, 2017
2. Rich E. & Knight K., Artificial Intelligence, 3rd edition, TMH, New Delhi.
3. Akerkar R. "Introduction to Artificial Intelligence", 2nd Edition, PHI Press, 2014.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) NA

POS MET THROUGH GAPS IN THE SYLLABUS :NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5

Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	1	1	1	2	1	3	2	3	2
CO2	3	2	2	3	3	2	1	1	3	3	2	3	2	2	1
CO3	3	2	2	2	3	2	2	2	3	3	1	3	2	3	2
CO4	2	3	2	2	2	3	2	1	3	3	1	3	2	2	3
CO5	3	3	2	3	2	3	2	2	2	1	2	2	2	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course Code: MA24201
Course Title: Numerical Methods
Pre-requisite(s):
Co- requisite(s): Numerical Methods Lab.
Credits: L: 2 T: 0 P: 0
Class schedule per week: 2 L
Class: B.Tech.
Semester / Level: III-IV/2
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	comprehend suitable numerical methods to solve algebraic and transcendental equations
	learn proper numerical methods to solve linear system of equations
	approximate a function using various interpolation techniques
	evaluation of derivatives and integrals using interpolating polynomials
	find the numerical solutions of initial value problems

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	solve algebraic and transcendental equations using numerical methods for real-world problem solving
CO2	apply numerical techniques to solve linear system of equations in scientific and engineering computations
CO3	use interpolation methods to approximate functions in data analysis and modeling
CO4	compute derivatives and integrals for complex mathematical and physical problems
CO5	solve ordinary differential equations numerically for dynamic system modeling and simulations

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: ERRORS AND NONLINEAR EQUATIONS Types and sources of errors, Propagation of errors. Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method and its variants, General Iterative method.	**5**
Module – II: SYSTEM OF LINEAR EQUATIONS Gaussian Elimination, Gauss-Jordan, LU Decomposition (Crout's method), Gauss-Jacobi and Gauss-Siedel methods to solve linear system of equations.	**5**

Module – III: INTERPOLATION Lagrange's interpolation, Newton's divided differences interpolation formulas, Interpolating polynomial using Newton forward and backward differences.	**5**
Module – IV: DIFFERENTIATION AND INTEGRATION Differentiation using interpolation formulas, Integration using Newton-Cotes formulas: Trapezoidal rule, Simpson's one-third and three-eighth rules.	**5**
Module – V: SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS Euler's method, modified Euler's method, Runge-Kutta Methods of second and fourth order to solve initial value problems.	**5**

TEXTBOOKS:

5. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publications, Fourth Edition, 2004.
6. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, Fourth Edition, 2005.
7. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

REFERENCE BOOKS:

4. S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, McGraw Hill, Seventh Edition, 2014.
5. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, Seventh Edition, 2003.
6. R. W. Hamming, Numerical Methods for Scientists and Engineers, Second Edition, Dover Publications Inc. 1987

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN --

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	√
CD 7	Teacher's Assessment	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO 1	3	3	2	2	2	0	1	0	0	1	1	2			
CO 2	3	3	2	2	2	0	1	0	0	1	1	2			
CO 3	3	2	2	2	3	0	1	0	0	1	1	2			
CO 4	3	2	2	2	3	0	1	0	0	1	1	2			
CO 5	3	3	2	3	3	0	1	0	0	1	1	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2.CD6
CO2	CD1, CD2.CD6
CO3	CD1, CD2.CD6
CO4	CD1, CD2.CD6
CO5	CD1, CD2.CD6

COURSE INFORMATION SHEET

Course Code: MA24202
Course Title: Numerical Methods Lab.
Pre-requisite(s): MA24201 Numerical Methods
Co- requisite(s): --
Credits: L: 0 T: 0 P: 2
Class schedule per week: 2 Sessional
Class: B.Tech.
Semester / Level: III-IV/2
Branch: All
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	execute appropriate numerical methods to solve algebraic and transcendental equations correct up to some certain level of significance
	solve linear system of equations using direct and iterative methods
	approximate a function by polynomial using various interpolation techniques along with computation of derivatives and integrals
	compute numerical solutions of initial value problems
	handle numerical problems efficiently through programming languages like C, C++ etc. on computer

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	employ numerical techniques to solve algebraic and transcendental equations
CO2	analyze and implement numerical methods for solving systems of linear equations
CO3	construct numerical approximations of functions using interpolation techniques
CO4	compute derivatives and definite integrals using numerical differentiation and integration methods
CO5	develop solutions of ordinary differential equations using appropriate numerical schemes

SYLLABUS

	List of Assignments
Write a program to	
1	find a simple root of $f(x) = 0$using Bisection method. Read the end points of the interval in which the root lies, maximum number of iterations and error tolerance eps.
2	find a simple root of $f(x) = 0$using Regula-Falsi method. Read the end points of the interval in which the root lies, maximum number of iterations and error tolerance eps.
3	find a simple root of $f(x) = 0$using Secant method. Read the end points of the interval in which the root lies, maximum number of iterations and error tolerance eps.
4	find a simple root of $f(x) = 0$using Newton Raphson method. Read any initial approximation, maximum number of iterationsand error tolerance eps.
5	find the solution of a system of linear equations using Gauss elimination method.

6	find the solution of a system of linear equations using Gauss-Jordan method.
7	find the solution of a system of linear equations using Jacobi method.
8	find the solution of a system of linear equations using Gauss-Seidel method.
9	approximate the function using Lagrange interpolation formula.
10	approximate the function using Newton divided difference formula.
11	approximate the function using Newton's forward and backward interpolation formulae.
12	evaluate the integral using Trapezoidal rule.
13	evaluate the integral using Simpson's one-third and three-eighth rules.
14	solve an IVP, $\frac{dy}{dx} = f(x,y), y(x_0) = y_0$using Euler method.
15	solve an IVP, $\frac{dy}{dx} = f(x,y), y(x_0) = y_0$ using the classical Runge-Kutta fourth order method.

TEXTBOOKS:

1. Jain M.K, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publications, 2004.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, Fourth Edition, 2005.
3. Y. Kanetkar, Let Us C, BPB Publications, Fifteenth Edition, 2016.

REFERENCE BOOKS:

- ✓ S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, McGraw Hill, Seventh Edition, 2014.
- ✓ R. W. Hamming, Numerical Methods for Scientists and Engineers, Second Edition, Dover Publications Inc. 1987.
- ✓ H. Schildt, C++: The Complete Reference, McGraw-Hill Education, Fourth Edition, 2017.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN --

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	60 % **Distribution**
Day to day performance and Lab. files	30
Lab. Quiz 1	10
Viva	20
End Semester Examination	40 % **Distribution**
Examination Experiment Performance	30
Lab. Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	√
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	
CD 7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO 1	3	2	1	2	3	0	0	0	1	1	1	2			
CO 2	3	3	2	2	3	0	0	0	1	1	1	2			
CO 3	3	2	2	2	3	0	0	0	1	1	1	2			
CO 4	3	2	2	2	3	0	0	0	1	1	1	2			
CO 5	3	3	2	3	3	0	0	0	1	1	2	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD2, CD3
CO2	CD2, CD3
CO3	CD2, CD3
CO4	CD2, CD3
CO5	CD2, CD3

COURSE INFORMATION SHEET

Course Code: CS24216
Course Title: Shell and Kernel Programming Lab
Pre-requisite(s): Data Structure and Algorithms, Computer Organization and Architecture, PPS
Co- requisite(s): Operating System
Credits: L:0 T: 0 P: 3
Class schedule per week: 3
Class: B.Tech.
Semester / Level: 4
Branch: CSE/AI-ML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Application of basic shell commands, pipes, redirections and filters.
	Learn use of shell scripts to automate tasks and manage system processes
	Gain exposure to low-level system programming in C using system calls
	Build system utilities, daemons, background processes, and services

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Apply shell scripting to automate daily administrative tasks.
CO2	Demonstrate usage of pipes, redirection, filters, and background processing.
CO3	Implement custom shell utilities, including basic shell interpreters.
CO4	Create simple system monitoring tools using system-level APIs
CO5	Perform file system operations, process management, system usage monitoring and signal handling using C.

SYLLABUS

MODULE	(NO. OF SESSIONS)
Module I: Linux Shell and Basic Scripting Unix/Linux commands, file/directory operations, searching, system info and permissions, introduction to pipes, analyzing logs, patterns, and system/network resource usages, shell scripting basics: variables, loops, conditionals, functions	**2**
Module II: Advanced Shell Scripting and System Automation Shell scripts with command-line arguments, Task automation using shell scripts, Job scheduling, script for process monitoring, memory/disk usage, kernel log monitoring, scripts to manage kernel modules, and fetch user/system info	**2**
Module III: System Calls File and directory handling using system calls. Writing C utilities for system info, permissions, and user data, Custom implementation of shell commands (cd, ls, echo, mkdir, cp, etc.), C programs to create and manage background processes and daemons	**3**
Module IV: Kernel Programming	**2**

Writing bootloader to print text using BIOS interrupts, writing, inserting and removing kernel modules, logging using printk and observing logs with dmesg, using module parameters with module_param	
Module V: System Calls and Kernel Threads adding a custom system call to the linux kernel, editing syscall tables and recompiling the kernel, writing user-space programs to invoke new syscall, creating kernel threads using kthread_run, thread synchronization and periodic logging with msleep, safe termination of kernel threads on module removal	**3**

TEXTBOOKS:

1. Shell Programming in Unix, Linux and OS X, Fourth Edition, Author(s): Stephen G. Kochan, Patrick Wood, Addison-Wesley Professional Publication, ISBN: 9780134496696.

REFERENCE BOOKS:

1. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 10th Edition, Wiley publication.
2. Unix and Shell Programming" Author: B. A. Forouzan, Richard F. Gilberg, 1st Edition, Cengage Learning.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

Semester End Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√

Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Lab Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Seminars
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	1	1	1	2	2	2	3	3	2	2
CO2	3	3	3	3	2	1	1	1	2	2	2	3	3	3	2
CO3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	2
CO4	3	3	3	3	2	1	1	1	2	2	3	3	3	3	2
CO5	3	3	3	3	2	1	1	1	2	2	3	3	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD2, CD3, CD4, CD6, CD7
CO4	CD2, CD3, CD4, CD7
CO5	CD2, CD3, CD4, CD5, CD7

COURSE INFORMATION SHEET

Course Code: CS2418

Course Title: Advanced Programming
Pre-requisite(s): PPS, DS
Co- requisite(s): -
Credits: 04 L: 0 T: 01 P: 03
Class schedule per week:
Class: B.Tech
Semester / Level:
Branch: CSE/ AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Develop a strong foundation in advanced Java programming concepts, including polymorphism, inheritance, threading, collections, JDBC, and functional programming.
	Apply Java programming techniques to solve complex real-world problems through robust, efficient, and scalable application design.
	Utilize multi-threading, concurrency, and Java frameworks to build high-performance, responsive applications.
	Gain expertise in integrating Java applications with databases, applying regular expressions, and utilizing lambda expressions for streamlined processing.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Apply object-oriented principles like polymorphism and inheritance to design Java applications.
CO2	Implement robust exception handling mechanisms and file operations to design reliable applications.
CO3	Develop high-performance, concurrent applications using Java threading and concurrency frameworks, ensuring efficient resource utilization.
CO4	Utilize the Java Collection Framework and generics to effectively manage and manipulate complex data structures with type safety.
CO5	Integrate Java applications with databases via JDBC, apply regular expressions for pattern matching, and use lambda expressions for streamlined functional programming.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Polymorphism and Inheritance** Overview of Object-Oriented Programming (OOP) principles, Wrapper Classes, String, StringBuffer, StringBuilder, Inheritance: Single, Multilevel, Hierarchical, and Hybrid, Polymorphism: Method Overloading and Method Overriding, Abstract Classes and Interfaces.	**3**
Module – II **Exception and File Handling** Fundamentals of Exception Handling, Types of Exceptions: Checked and Unchecked, Try-Catch, Throw, Throws, Finally blocks, Designing Custom	**2**

Exceptions, rethrowing exceptions. File Handling: FileReader, FileWriter, BufferedReader, BufferedWriter, Serialization & Deserialization	
Module – III **Threading** Introduction to Threads and Multithreading, Thread Lifecycle and States, Creating Threads: Extending Thread Class, Implementing Runnable Interface, Synchronization and Inter-thread Communication, Deadlocks, Thread Pooling, Thread priority, Thread Group, Daemon Thread.	**3**
Module – IV **Java Collection Framework & Generic Classes** Introduction to Java Collections Framework, Collections Interfaces: List, Set, Queue, Collection Classes: ArrayList, LinkedList, HashSet, TreeSet, HashMap, TreeMap, Iterators and Enhanced for-loop. Generics: Creating Generic Classes, Methods and Interfaces.	**3**
Module – V JDBC, Regular Expressions & Lambda Expressions Overview of JDBC Architecture, Establishing Database, Connection, Executing SQL Queries Regular Expressions: Syntax and Pattern Matching, Classes: Pattern, Matcher, Use case for Data Validation, Parsing, Text Manipulation. Lambda Expression: Introduction to Functional Programming, Syntax and Functional Interfaces, default methods, predicates.	**2**

TEXTBOOKS:

- Java: The Complete Reference, Herbert Schildt, Dr. Coward, Danny, 13th Edition, McGrawHill Publications

REFERENCE BOOKS:

- Programming with Java, Beginner to Advanced, Cay S. Horstmann, 7th Edition, Wiley
- Java How to Program, Deitel P., Deitel H., Pearson Publications, 2016.
- Object Oriented Programming in Java, Wu C. T, McGrawHill Publications

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60

End Semester Assessment	40

Continuous Internal Assessment	**% Distribution**
Day-to-day performance	20
Quiz	10
Viva	20
End Semester Assessment	**% Distribution**
Performance	30
Quiz	20

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	
CD2	
CD3	
CD4	
CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**
CO5	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: AI24301
Course Title: Natural Language Processing
Pre-requisite(s): Mathematics for AI-ML (AI24201)
Co- requisite(s): Machine Learning Techniques (AI24303)
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: BTech
Semester / Level:
Branch: CS/AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To understand the fundamental techniques of Natural language processing
	To analyze the syntax, semantics, and pragmatics of the text in natural language
	To enable the application of deep learning for NLP applications
	To develop real-world NLP projects such as Sentiment Analysis, Name Entity Recognition, Machine Translation,

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Understand the fundamentals of natural language processing and basic text processing techniques.
CO2	Analyze syntactic structures and implement parsing algorithms.
CO3	Interpret word meanings and perform semantic analysis using lexical databases and embeddings.
CO4	Apply deep learning models to solve NLP problems.
CO5	Develop NLP applications such as chatbots, translators, and sentiment analyzers with ethical considerations.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Introduction to NLP Introduction to NLP and its Applications, Natural Language Components: Morphology, Syntax, Semantics, Pragmatics, Text Preprocessing: Tokenization, Lemmatization, Stop-word removal, Normalization; Regular Expressions, Language Models Overview	**6**
Module – II: Syntax Analysis and Parsing N-gram language models, Smoothing techniques; Part-of-Speech (POS) tagging: Rule-based, HMM-based; Syntactic Parsing: Context-Free Grammars (CFGs),	**8**

Recursive descent parsing, Probabilistic Parsing, Dependency Parsing; Evaluation: Precision, Recall, F1-score	
Module – III: Semantics and Lexical Resources Lexical Semantics and Word Sense Disambiguation (WSD), WordNet and lexical database, Semantic similarity, Cosine similarity Vector Space Models: TF-IDF, Word embeddings: Word2Vec, GloVe, FastText	**8**
Module – IV: Neural Approaches Convolutional Neural Network, Sequence Modelling: RNNs, LSTMs, Transformer, Encoder-Decoder Architecture, Transfer Learning: BERT, GPT	**10**
Module – V: NLP Applications and Ethics Text classification and Sentiment analysis, Named Entity Recognition (NER), Machine Translation: Rule-based, SMT, NMT, Chatbots and Dialog Systems, Ethics in NLP: Bias, Fairness, Explainability	**8**

TEXTBOOKS:

5. Speech and Language Processing – Daniel Jurafsky & James H. Martin, Pearson Education, 2nd Edition
6. Foundations of Statistical Natural Language Processing – Christopher D. Manning & Hinrich Schütze, MIT Press, 1st edition.

REFERENCE BOOKS:

7. Neural Network Methods in NLP – Yoav Goldberg, Morgan & Claypool Publishers, 1st edition.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
	25
	50

Continuous Internal Assessment	% Distribution
	10+10

	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP
CD2	Projectors
CD3	Tutorials/Assignments
CD4	Seminars
CD5	Mini projects
CD6	Expert talks
CD7	Self- learning such as use of NPTEL materials and

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	2	1	1	2	2	3	2	1
CO2	3	2	3	2	2	2	1	1	1	1	1	1	3	2	1
CO3	3	2	3	2	2	2	1	1	1	1	1	1	3	2	1
CO4	2	3	3	3	3	3	1	2	3	1	2	3	3	3	2
CO5	2	3	3	3	3	3	1	3	3	2	3	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	Lecture by use of boards/LCD projectors/OHP

	Projectors, Tutorials/Assignments
CO2	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO3	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO4	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO5	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments

COURSE INFORMATION SHEET

Course Code: AI24302
Course Title: Introduction to NLP Lab
Pre-requisite(s):
Co- requisite(s): AI24301 Introduction to NLP
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class:
Semester / Level:
Branch: CSE/ AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

●	Provide hands-on experience with text preprocessing techniques and NLP libraries.
●	Implement key algorithms like POS tagging, parsing, and word embeddings.
●	Train and evaluate deep learning models (RNNs, LSTMs, Transformers) for NLP tasks.
●	Build real-world NLP applications like sentiment analysis, machine translation, and chatbots. Encourage the use of ethical AI practices in NLP solutions.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Apply basic NLP preprocessing techniques using Python libraries.
CO2	Implement and evaluate POS tagging and parsing algorithms.
CO3	Use lexical databases and word embedding techniques for semantic analysis.
CO4	Train deep learning models for sequence modeling and text classification.
CO5	Develop practical NLP applications with ethical considerations.

SYLLABUS

MODULE	(NO. OF Labs)
Module – I **Text preprocessing: Tokenization, stemming, lemmatization, stopword removal,** **Regular expressions for text pattern extraction**	**2**
Module – II **N-gram language model and text generation** **POS tagging using NLTK/spaCy – rule-based and HMM-based models** **Parsing techniques: CFG, dependency parsing with spaCy**	**3**
Module – III **WordNet and Word Sense Disambiguation using Lesk algorithm** **Vector Space Models: TF-IDF, Cosine similarity** **Word embeddings: Word2Vec, GloVe, FastText**	**2**

Module – IV **Text classification using CNN/RNN** **Sequence modeling with LSTM for language modeling or translation** **Transformer and BERT-based classification or Q&A system**	**3**
Module – V **Named Entity Recognition using spaCy or BERT** **Sentiment Analysis on real-world datasets (IMDB, Twitter)** **Mini-project: Chatbot/Dialog system using Transformer-based models**	**2**

TEXTBOOKS:
Textbook:
Daniel Jurafsky and James H. Martin, Speech and Language Processing, 2nd Edition, Pearson Education, 2009.

Reference Books:

5. **Christopher D. Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press, 1st Edition, 1999.**
6. **Yoav Goldberg, Neural Network Methods in Natural Language Processing, Morgan & Claypool Publishers, 1st Edition, 2017.**
7. **Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2nd Edition, 2023.**
8. **Delip Rao and Brian McMahan, Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning, O'Reilly Media, 1st Edition, 2019.**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

8. **Student Feedback on Course Outcome**
9. **Student Feedback on Faculty/Content Delivery**
10. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course/ Outcomes	**Program outcomes (PO)**												**Program specific outcomes (PSO)**		
AI24302	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	1	2	2	1	2	2	3	2
CO2	3	3	3	3	3	3	3	1	3	3	1	2	3	3	3
CO3	3	3	3	3	2	2	1	1	2	2	1	2	3	3	2
CO4	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2
CO5	3	3	3	3	3	2	1	1	1	2	1	2	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: CS24303
Course Title: Data Mining Concepts and Techniques
Pre-requisite(s): Database Management System
Co- requisite(s):
Credits: L: 3 T: 0 P 0:
Class schedule per week: 3
Class: Theory
Semester / Level: 5
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Examine the types of the data to be mined and apply pre-processing methods on raw data.
	Get the basic concepts of Data Mining techniques and various data visualization techniques
	Practice the Data Warehousing and OLAP methods
	Kknow methods of basic and advanced Frequent pattern mining.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Illustrate the fundamentals of data mining systems as well as issues related to access and retrieval of data at scale.
CO2	Apply the various data preprocessing techniques.
CO3	Demonstrate the various data warehousing functionalities and the cube Technologies
CO4	Analyze different approaches of frequent pattern mining for their applicability.
CO5	Evaluate advanced pattern mining for exploration and applications

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Data Mining: Introduction, Relational Databases, Data Warehouses, Transactional databases, Advanced database Systems and Application, Data Mining Functionalities, Classification of Data Mining Systems, Major Issues in Data Mining. Getting to Know Your: Data, Data Objects and Attribute Types , Basic Statistical Descriptions of Data , Data Visualization, Measuring Data Similarity and Dissimilarity	**8 Hrs.**
Module – II	**8 Hr.**

Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.	
Module – III Data Warehouse: Basic Concepts, DataWarehouse Modeling: Data Cube and OLAP, DataWarehouse Design and Usage, DataWarehouse Implementation, Data Generalization by Attribute-Oriented Induction, Data Cube Computation: Preliminary Concepts	**8 Hr.**
Module – IV Mining Frequent Patterns, Associations, and Correlations: Basic Concepts, Frequent Itemset Mining Methods, Apriori Algorithm, A Pattern-Growth Approach, Interesting Pattern Evaluation Methods	**8 Hr.**
Module – V Advanced Pattern Mining: Pattern Mining: A Road Map, Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns, Mining Compressed or Approximate Patterns, Pattern Exploration and Application.	**8 Hr.**

TEXTBOOKS:

Jiawei Han, and Micheline Kamber, "Data Mining Concepts & Techniques", 7th Edition, Publisher Elsevier India Private Limited

REFERENCE BOOKS:

Mohammed J. Zaki, and Wagner Meira Jr., "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2016.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50

Continuous Internal Assessment	% Distribution
Assignment / Quiz (s)	10+10
Teacher's Assesment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects
CD5	Expert talks
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course/ Outcomes	**Program outcomes (PO)**												**Program specific outcomes (PSO)**		
CS24303	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	2	2	2	1	2	2	1	1	3	3	1
CO2	2	3	2	3	2	2	1	2	2	2	2	1	2	2	2
CO3	2	3	3	3	3	3	3	2	3	2	3	1	2	2	3
CO4	3	2	2	3	3	2	2	1	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	2	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO2	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments

CO3	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO4	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO5	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments

COURSE INFORMATION SHEET

Course Code: CS24305
Course Title: Data Communication & Computer Networks
Pre-requisite(s): Operating System, Digital System Design
Co- requisite(s):
Credits: L: 3 T: 1 P: 0
Class schedule per week: 4
Class: B.Tech.
Semester / Level: V
Branch: CS/AI-ML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Study the basic communication model, types of networks, network models, protocols, and applications.
	Understand characteristics of transmission media, types of impairments, signal encoding techniques, error detection and correction methods.
	Understand principles of multiplexing, wide area network technology and cellular wireless networks.
	Understand the underlying technology and protocol architecture of local area networks, internetworking concepts, IP addressing, routing techniques, and transport protocols.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Comprehend communication protocol architecture, identify network types and map functions to real-life applications.
CO2	Examine signal impairments, determine channel capacity, analyze transmission characteristics of different mediums, simulate analog and digital signaling methods, encoding techniques, bandwidth utilization and compare efficiency.
CO3	Analyze error and flow control mechanisms in data link layer and provide solutions.
CO4	Describe the key elements of circuit switching networks, packet switching technology, provide an overview of cellular network organization, and analyze local area network architecture.
CO5	Experiment with internetworking protocols, analyze and compare their functions and evaluate efficiency with various routing, transport and congestion control protocols.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Data Communications and Networking Overview**: A Communications Model, Data Communications, Networks, Internet, OSI, TCP/IP Protocol Architecture, Standards and Protocol Layers, Internet Applications, Data Transmission Concepts and Terminology, Analog and Digital Data Transmission, Transmission	**8**

Impairments, Channel Capacity.	
Module – II **Transmission Media and Signal Encoding Techniques:** Guided Transmission Mediums, Wireless Transmission and Propagation, Digital Signaling and Analog Signaling, Encoding Techniques, Modulation Techniques.	**8**
Module – III **Error Handling, Data Link Control Protocols and Multiplexing:** Types of Errors, Error Detection and Correction Techniques, Flow Control, Error Control, High-Level Data Link Control (HDLC), Frequency Division Multiplexing, Time Division Multiplexing.	**8**
Module – IV **Wide Area Networks and Local Area Networks**: Switching Network, Circuit-Switching Networks, Circuit-Switching Concepts, Packet-Switching Principles, Principles of Cellular Networks, Cellular Network Generations, Topologies, LAN Protocol Architecture, Virtual LANs.	**8**
Module – V **Ethernet, Wireless LAN Overview and Internetworking:** Traditional and High-Speed Ethernet, IEEE 802.11, Internet Protocol, IP Addressing, Transport Protocols, Routing in Packet Switching Networks, Routing Protocols (Distance Vector, Link State, Path Vector), Congestion Control, Traffic Management, SMTP, DNS, HTTP, DHCP.	**8**

TEXTBOOKS: Stallings W., Data and Computer Communications, 10th Edition, Pearson Education, PHI, New Delhi, 2017

REFERENCE BOOKS: Forouzan B. A., Data Communications and Networking, 6th Edition, TMH, New Delhi, 2022.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS):

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester examination	50

Continuous Internal Assessment	% Distribution
Quiz (s)	10
Assignment/Quiz (s)	10
Teacher's Assessment	05
Mid Semester Examination	25

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
End Semester Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Laboratory experiments/teaching aids/ Seminars
CD4	Mini projects
CD5	Industrial visits/in-plant training/Expert talks
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1	1	0	2	2	1	3	3	3	3
CO2	3	2	2	2	2	1	1	0	2	2	1	3	3	3	3
CO3	3	3	2	2	2	2	1	0	2	3	1	3	3	3	3
CO4	3	3	3	3	3	2	1	1	2	3	2	3	3	3	3
CO5	3	3	3	3	3	2	2	2	2	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD3, CD4, CD6, CD7
CO4	CD1, CD2, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

COURSE INFORMATION SHEET

Course Code: CS24306
Course Title: Data Communication & Computer Networks Lab
Pre-requisite(s): Operating System, Digital System Design
Co- requisite(s):
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B.Tech.
Semester / Level: V
Branch: CS/AI-ML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Explore and simulate various networking commands to manage and monitor computer networks.
	Understand and analyze different types of framing, error detecting and correcting methods.
	Simulate internetwork, perform packet sniffing, analyze network traffic and perform traffic management.
	Understand and implement network communication between processes, whether on the same machine or across a network

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Administer and maintain a computer network, understand network principles, and troubleshoot common network issues.
CO2	Understand and apply various techniques for data transmission and error handling at data link layer.
CO3	Understand and troubleshoot network issues, monitor network activity, interpret captured packets, and analyze traffic patterns.
CO4	Design sub-netting and analyze the performance of network layer with various routing protocols.
CO5	Analyze various congestion control techniques and develop programs for client-server applications.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I ● Learn the usage of networking commands in XNIX and Windows environments to configure, manage, and troubleshoot connectivity. ● Simulate the working of ARP and IP forwarding within a LAN and demonstrate observations.	**3**

Module – II 1. Write programs to understand the working of data link layer framing methods. 2. Simulate and understand the working of character stuffing and bit stuffing methods for HDLC frames and demonstrate observations. 3. Write programs and simulate to understand Hamming code generation and checksum methods for error detection and correction and demonstrate observations.	**6**
Module – III 1. Write programs and simulate the working of various Cyclic Redundancy Check (CRC) polynomial methods (CRC 12, CRC 16, CRC CCITT and CRC 32) for error detection and demonstrate observations. 2. Design a Network Scenario with subnets and routers. Simulate and analyze this Network to understand the flow of traffic and demonstrate observations. 3. Simulate and analyze a network scenario to understand traffic generation rate and service rate by changing different Network parameters and demonstrate observations.	**6**
Module – IV 1. Write program to demonstrate Hostname, IPV4 address, network class (A, B, C, D, or E), Network ID, 32-bit address, and Host ID of a given system. 2. Simulate and analyze Dijkstra's algorithm to compute the shortest path through an internetwork by changing different network parameters and demonstrate observations. 3. Simulate and analyze Distance Vector routing algorithm through an internetwork by changing different network parameters and demonstrate observations. 4. Simulate and analyze various congestion control techniques.	**6**
Module – V 1. Implementation of Client-Server applications using inter process communication mechanisms a) FIFO b) Message queues c) Shared memory 2. Implementation of Connection-oriented Client-Server applications based on BSD sockets. 3. Implementation of Connectionless Client-Server applications and Chat servers. 4. Client-Server applications based on Raw Sockets, IP Spoofing.	**6**

TEXTBOOKS: Stallings W., Data and Computer Communications, 10th Edition, Pearson Education, PHI, New Delhi, 2017

REFERENCE BOOKS: Forouzan B. A., Data Communications and Networking, 6th Edition, TMH, New Delhi, 2022.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS):

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of smart boards/LCD projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aid/Seminar/Coding
CD4	Mini Projects
CD5	Industrial visits/in-plant training/Guest Lectures
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO 1	3	2	2	2	2	1	1	0	2	2	1	3	3	3	3
CO 2	3	2	2	2	2	1	1	0	2	2	1	3	3	3	3
CO 3	3	3	2	2	2	2	1	0	2	3	1	3	3	3	3
CO 4	3	3	3	3	3	2	1	1	2	3	2	3	3	3	3
CO 5	3	3	3	3	3	2	2	2	2	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6, CD7
CO2	CD1, CD2, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD2, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

RANCHI

COURSE INFORMATION SHEET

Course Code: AI24303
Course Title: Machine Learning Techniques
Pre-requisite(s): Maths for AIML
Co- requisite(s): -
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the foundational concepts and types of Machine Learning including supervised and unsupervised learning.
	Develop regression models using linear and regularized approaches, and evaluate them using suitable metrics.
	Explore and implement various classification algorithms and understand their theoretical foundations.
	Apply clustering techniques and dimensionality reduction methods to analyze unlabeled data.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Understand the fundamental concepts, types, and key terminologies in Machine Learning.
CO2	Apply and evaluate supervised learning techniques such as regression and classification using appropriate models and metrics.
CO3	Design and implement neural network architectures including perceptron and multilayer networks for pattern recognition tasks.
CO4	Apply unsupervised learning methods like clustering and dimensionality reduction to explore and analyze unlabeled data.
CO5	Differentiate and assess various clustering algorithms and understand the concept of semi-supervised learning.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Machine Learning and Supervised Learning (Regression) Introduction to Machine Learning: Definitions, Types (Supervised, Unsupervised, Reinforcement), Key Terminologies: Features, Labels, Training/Test Sets, Overfitting, Underfitting, Bias-Variance Tradeoff	**8**

Regression: Linear Regression: Concept, Assumptions, Gradient Descent, Evaluation, Polynomial Regression, Ridge and Lasso Regression, Evaluation of Regression Models: MSE, RMSE, MAE, R^2 Score	
Module – II Supervised Learning – II (Classification Techniques) Logistic Regression, k-Nearest Neighbors (kNN), Support Vector Machines (SVMs): Linear and Kernel-based, Naive Bayes Classifier, Decision Trees: Constructing Decision Trees, Attribute selection for splitting, ID3, Gini Index, CART, Random Forests	**8**
Module – III Supervised Learning – III (Neural Network) Hebb's rule, McCullogh and Pitts Neurons, Perceptron Algorithm; concept of Linear Separability, Decision Boundary for a single Neuron; The Multilayer Perceptron (MLP), Error Propagation, Delta Rule, Back Propagation Algorithm.	**8**
Module – IV Unsupervised Learning – I Introduction to Clustering, proximity matrix, dendrogram, Distance Metrics. Dimensionality Reduction: PCA. Hierarchical Clustering: Single link vs. complete link, Agglomerative vs. Divisive clustering, Probabilistic clustering	**8**
Module – V Unsupervised Learning – II Partition based Clustering: Iterative Partition cluster method, K-Means Algorithm, K-Medoids Algorithm. Density based Clustering: Introduction, Algorithms for clustering categorical data, Defining density for clustering, DBSCAN Estimating cluster validity: Purity, Maximum Matching, F-Measure, Jaccard Coefficient, Silhouette Coefficient Concept of Semi-supervised learning	**8**

TEXTBOOKS:

- Marsland S., Machine Learning: An Algorithmic Perspective", CRC Press.
- King, R.S., Cluster Analysis and Data Mining: An Introduction, Mercury Learning and Information

REFERENCE BOOKS:

5. Tom M. Mitchell, "Machine Learning ", Tata McGraw Hill, New Delhi, 2017
6. Shalev-Shwartz Shai and Ben-David Shai, Understanding Machine Learning, Cambridge University Press, 2017.
7. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment

Continuous Internal Assessment	% Distribution

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	
CD2	
CD3	
CD4	
CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	0	0	0	0	1	1	2	1	3	1
CO2	3	3	3	2	1	0	0	0	0	1	1	2	1	3	1
CO3	3	3	3	2	2	0	0	0	0	1	1	2	2	3	1
CO4	3	3	3	2	2	0	0	0	0	1	1	2	2	3	1
CO5	3	3	3	3	3	0	0	0	0	1	1	2	2	3	1

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: AI24304

Course Title: Machine Learning Techniques Lab

Pre-requisite(s): Mathematics for AI-ML

Co- requisite(s): -

Credits: L: 0 T: 0 P: 3

Class schedule per week:

Class:

Semester / Level:

Branch:

Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the foundational concepts and types of Machine Learning including supervised and unsupervised learning.
	Develop regression models using linear and regularized approaches, and evaluate them using suitable metrics.
	Explore and implement various classification algorithms and understand their theoretical foundations.
	Apply clustering techniques and dimensionality reduction methods to analyze unlabeled data.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Preprocess and visualize data for machine learning tasks
CO2	Understand and implement basic supervised learning algorithms
CO3	Explore dimensionality reduction techniques
CO4	Design and apply unsupervised learning techniques
CO5	Analyze performance metrics of supervised and unsupervised models

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Machine Learning and Supervised Learning (Regression) Programs based on Linear Regression, Gradient Descent, Polynomial Regression, Ridge and Lasso Regression and implementation of different evaluation metrics like MSE, RMSE, MAE, R^2 Score	**2**
Module – II Supervised Learning – II (Classification Techniques) Programs based on Logistic Regression, k-Nearest Neighbors (kNN). Programs on Support Vector Machines (SVMs) using linear different kernel approaches. Programs based on implementing Naive Bayes Classifier, Decision Trees and Random Forests on a given dataset.	**3**
Module – III Supervised Learning – III (Neural Network) Programs based on understanding the concept of linear separability. Programs based on Multilayer Perceptron (MLP) and Back Propagation Algorithm.	**3**
Module – IV Unsupervised Learning – I Programs based on Dimensionality Reduction: PCA. Programs based on Hierarchical and Probabilistic clustering methods	**2**
Module – V Unsupervised Learning – II Programs based on Partition based Clustering: Iterative Partition cluster method, K-Means Algorithm, K-Medoids Algorithm. Programs based on Density based Clustering: DBSCAN Programs based on Estimating cluster validity	**3**

TEXTBOOKS:

1. Aurelien Géron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd ESeptember 21019, O'Reilly Media, Inc., ISBN: 9781492032649.

REFERENCE BOOKS:

1. Tom M. Mitchell, "Machine Learning ", Tata McGraw Hill, New Delhi, 2017
2. Shalev-Shwartz Shai and Ben-David Shai, Understanding Machine Learning, Cambridge University Press, 2017.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer,

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment

Continuous Internal Assessment	% Distribution

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	
CD2	
CD3	
CD4	

CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	0	0	0	0	1	1	2	1	3	1
CO2	3	3	3	2	1	0	0	0	0	1	1	2	1	3	1
CO3	3	3	3	2	2	0	0	0	0	1	1	2	2	3	1
CO4	3	3	3	2	2	0	0	0	0	1	1	2	2	3	1
CO5	3	3	3	3	3	0	0	0	0	1	1	2	2	3	1

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation -3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: AI24313
Course Title: Deep Learning
Pre-requisite(s): Mathematics for AI-ML
Co- requisite(s):
Credits: L:3 T: 0 P: 0
Class schedule per week: 3
Class:
Semester / Level:
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

●	Understand the basic component of Deep Learning.
●	Explore the application areas of Neural Networks and map a problem.
●	Design Convolution Neural Networks.
●	Design Recurrent Neural Networks.
●	Explore Generative Learning models.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Understand the foundation and application of deep learning networks
CO2	Design deep neural networks and fit models for specific applications.
CO3	Implement CNN and other pre-trained models.
CO4	Implement RNN based model.
CO5	Apply Generative Learning-based models.

SYLLABUS

Module 1: Introduction **[8 Lectures]**
Introduction to deep learning, logical computations with neurons, hidden layers, activation functions, loss function and cross entropy loss, perceptron, backpropagation, applications, and use-cases for industry

Module 2: Fitting models **[8 Lectures]**
Training a deep neural network (DNN),Gradient descent, Stochastic Gradient descent, Momentum, Adam, Training hyperparameters, Computing derivatives, Back propogation, Parameter Initialization. vanishing/exploding gradient issues, reusing pretrained layers, optimizers, l1 and l2 regularization, dropout

Module 3: Deep Neural Networks I **[8 Lectures]**
Convolutional neural networks (CNNs): convolutional layer, filters, stacking, pooling layer, CNN architectures
Pretrained Models: VGG16. VGG19. Alex-Net. Res-Net

Module 4: Deep Neural Networks II **[8 Lectures]**

Recurrent neural networks (RNNs): recurrent neurons, unrolling, input and output sequences, training RNNs, deep RNNs, LSTM cell, GRU cell

Module 5: Generative Learning **[8 Lectures]**
Representation Learning and Generative Learning: Auto encoders: data representations, linear auto encoder, stacked auto encoders, variational auto encoders

TEXTBOOKS:

Text Books:

8. Prince, S., J., D., Understanding Deep Learning, MIT Press, 1st Edition, 2024

Reference Books:

5. Bishop C., Bishop H., Deep Learning: Foundations and Concepts, Springer, 1st Edition, 2024
6. Dawani, J., Hands on Mathematics for Deep Learning, Packt Publishing, 1st Edition, 2020
7. Deep Learning with Python by Francois Chollet, Publisher : Manning Publication , Second Edition , 2021

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

4. **Student Feedback on Course Outcome**
5. **Student Feedback on Faculty/Content Delivery**
6. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	√
CD 7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes(PSOs)**		
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	1	1	1	2	2	3	2	1
CO2	3	3	3	3	3	2	1	3	2	2	1	2	3	3	2
CO3	3	3	3	3	3	2	2	3	1	1	2	1	3	3	2
CO4	3	3	3	3	3	2	1	3	1	1	1	1	3	3	2
CO5	3	3	3	3	3	2	1	3	1	2	1	1	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	**Course Delivery Method**
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: CS24315
Course Title: Introduction to Cyber Security
Pre-requisite(s): Foundational Cryptography, Security Principles and Computer Network
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3 L
Class: B. Tech.
Semester / Level: 3/ II
Branch: CSE
Name of Teacher: Dr. Sandip Dutta, Dr. Prashant Pranav, Dr. J Sengupta, Dr. S. S. Sahoo

COURSE OBJECTIVES

This course envisions to impart the students to:

	Understand the foundational principles of cybersecurity, including threats, vulnerabilities, attacks, and controls.
	Analyze and classify different types of cybercrimes from local and global perspectives, including cloud and mobile device-related crimes.
	Develop hands-on skills in identifying and mitigating cyber-attacks through vulnerability scanning, penetration testing, and network analysis tools.
	Understand the integration of quantum cryptography with cybersecurity, including emerging paradigms like Quantum Key Distribution (QKD) and Post-Quantum Cryptography.
	Gain knowledge of cyber laws and legal frameworks, including the Indian IT Act 2000, to recognize and respond to cyber offenses and regulatory requirements.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Identify and analyze various cybersecurity threats, vulnerabilities, and associated attack vectors.
CO2	Demonstrate proficiency in conducting network vulnerability assessments and using cybersecurity tools such as OpenVAS, Metasploit, Netcat, and Socat.
CO3	Apply digital forensic techniques to collect, preserve, and analyze digital evidence following legal and ethical standards.
CO4	Explain and evaluate the role of quantum cryptography and post-quantum cryptographic approaches in enhancing cybersecurity.
CO5	Interpret and apply cybercrime laws, including the Indian IT Act 2000, and develop appropriate strategies for incident response and cyber investigation.

SYLLABUS

MODULE	**(NO. OF LECTURE HOURS)**

Module – I: Introduction to Cyber Security **Computer Security:** Introduction: Basic concepts and terminology in cybersecurity, Motivation to study cybersecurity, real world examples of cyberattacks, Branches of cybersecurity, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography.	**8**
Module – II: Cyber Attacks and Defense **Malware:** Virus, worms, trojan horse, rootkit, zombie, bot, botnet, ransomware, Bug: buffer overflow, integer overflow, TOCTTOU, covert channel, Security model: threat model, trust model, trusted computing base, Security principles and countermeasures.	**6**
Module – II: Web Security Security architecture of World Wide Web, Security Architecture of Web Servers, and Web Clients Browser Attacks, Web Attacks Targeting Users: Cross Site Scripting Attacks, Cross Site Request Forgery, SQL Injection Attacks, Obtaining User or Website Data, Email Attacks, Content Security Policies (CSP) in web Session Management and User Authentication, Session Integrity	**8**
Module – III: Network Vulnerabilities Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS. Networks Vulnerability Scanning (Netcat, Socat), Network Sniffers and Injection DOS and DDOS attack, Attack on wireless Networks.	**6**
Module – IV: Web Application and Network Defense Tools **Scanning for web vulnerabilities tools:** Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel. Application Inspection tools – Zed Attack Proxy, Sqlmap, DVWA, Webgoat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, Pwdump **Firewalls and Packet Filters:** Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, VPN: the basic of Virtual Private Networks, Firewall: Introduction, Linux Firewall, Windows Firewall, Snort: Intrusion Detection System.	**10**

Module – V: Introduction to Cyber Crime, law and Investigation **Cyber Crimes:** Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. **Internet crime and Act:** A Brief History of the Internet, Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT 2000.	**2**

TEXTBOOKS:

- William Stallings and Lawrie Brown, Computer Security: Principles and Practice, Boston, Massachusetts: Pearson Education, 2018.

REFERENCE BOOKS:

- Dafydd Stuttard and Marcus Pinto, The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Indianapolis, Indiana: Wiley Publishing, 2011.
- Daniel J. Bernstein, Johannes Buchmann, and Erik Dahmen (Editors), Post-Quantum Cryptography, Berlin, Germany: Springer, 2009.
- Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, London, United Kingdom: Routledge, 2017.
- Chris McNab, Network Security Assessment: Know Your Network, Sebastopol, California: O'Reilly Media, 2016.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS): NA

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50

End Semester Examination	50

Continuous Internal Assessment	**% Distribution**
Mid Semester Examination	25
Quiz 1	10
Quiz 2	10
Assignment/ Assessment	5

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/assignments
CD3	Mini projects/projects
CD4	Self- learning such as use of NPTEL materials and internets

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	0	0	0	2	0	2	3	3	1
CO2	3	3	3	3	2	1	0	0	0	2	0	3	3	3	1
CO3	3	3	3	3	2	1	0	0	0	2	0	3	3	3	1
CO4	3	3	3	3	2	1	0	0	0	2	0	3	3	3	1
CO5	3	3	3	3	3	1	0	0	0	2	0	2	3	3	1

Grading: No Correlation – 0, Low Correlation - 1, Moderate Correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	**Course Delivery Method**
CO1	CD1
CO2	CD1, CD2
CO3	CD1, CD2, CD3

CO4	CD1, CD4
CO5	CD1, CD4

COURSE INFORMATION SHEET

Course Code: CS24318
Course Title: Embedded Systems Lab
Pre-requisite(s):
Co- requisite(s):
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B. Tech
Semester / Level:
Branch: CS
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1	Develop a foundational understanding of microcontroller boards, pin configurations, and basic electronic interfacing.
2	Gain hands-on experience in interfacing basic I/O devices including LEDs, buttons, and sensors.
3	Learn the application of timers, interrupts, ADC, and PWM through practical experiments.
4	Interface and program advanced peripherals such as motors, displays, joysticks, and motion sensors for real-world applications.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Demonstrate understanding of embedded system hardware by configuring microcontroller pins and interfacing basic components such as LEDs and push buttons.
CO2	Write programs to handle external interrupts and use timers effectively in embedded applications.
CO3	Implement analog signal acquisition and manipulation using ADC, potentiometers, and temperature sensors, and control outputs using PWM techniques.
CO4	Interface and control peripheral devices including LCDs, seven-segment displays, RGB LEDs, and motors to design mini embedded systems.
CO5	Integrate and test advanced input/output peripherals like buzzers, keypads, joysticks, photoresistors, and motion sensors to develop interactive embedded applications.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Introductory Experiments Working with boards, Understanding Pin layouts, Connecting LEDs, Manipulating LEDs, Working with Bread boards	**2**
Module – II: Introductory Experiments – II Interfacing with push buttons, Multi coloured LEDs, Writing simple IRQs, Working with timers,	**2**

Module – III : ADC based experiments Understanding ADC and its working, Working with analog sensors, Measuring temperature, working with potentiometers.Interfacing with pulse width modulation pins,	**3**
Module – IV: Interfacing Peripherals Setting up LCD displays, Single and multiple Seven Segment displays, RGB LED Bars, Working with motors, Interfacing additional peripherals e.g. Distance measurements, Motion Sensors, IR remotes etc.	**3**
Module – V: Interfacing advanced peripherals Working with buzzers, keypads, analog joysticks, photo resistors, accelerometers, gyroscopes etc.	**3**

TEXTBOOKS:

Raj Kamal, "Embedded Systems- Architecture, Programming and Design", McGraw Hill Education India

REFERENCE BOOKS:

(1) Michael Barr and Anthony Massa, "Programming Embedded Systems in C and C++", O'Reilly Media
(2) Edward A. Lee and Sanjit A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", Free PDF version from UC Berkeley

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

Semester End Examination	% Distribution
Examination Experiment Performance	30

Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Lab Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Seminars
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	2	1	1	1	2	1	3	3	1
CO2	3	3	3	3	3	1	0	0	0	1	0	0	3	2	0
CO3	3	3	3	3	3	2	2	1	1	1	2	0	3	3	2
CO4	3	3	3	3	2	0	1	0	0	0	1	0	3	3	0
CO5	3	3	3	3	2	2	1	1	0	2	2	1	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD2, CD3, CD4, CD6, CD7
CO4	CD2, CD3, CD4, CD7
CO5	CD2, CD3, CD4, CD5, CD7

COURSE INFORMATION SHEET

Course Code: AI24351
Course Title: FORMAL LANGUAGE AND AUTOMATA THEORY
Pre-requisite(s): Elementary discrete mathematics including the notion of set, function, relation, product, partial order, equivalence relation and graph
Co- requisite(s): Nil
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class: B.TECH
Semester / Level: III
Branch: Computer Sc. and Engg
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Define a system (state machine) and recognize the behavior of a system.
	Design finite state machine, learn the formalism of regular expression (regex) to represent patterns of interest required in various applications and to convert deterministic finite automata (DFA) to regular expression and the reverse.
	Acquire skills in writing formal version of grammar of langauge, specifically context free grammar (CFG) to capture the syntactic structure of objects of interest and construct pushdown automata (PDA) of the equivalent CFG
	Understand the limitations of FA and PDA and design Turing machines (TM) for the problems of interest
	Learn about a more formal understanding of different types of problems, algorithms and procedures.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Relate formal languages and mathematical models of computation
CO2	Construct mathematical computation models and connect them to the appropriate formal languages
CO3	Utilize regular expressions to delineate formal languages and implement characteristics of regular languages in practical contexts.
CO4	Apply the power of Pushdown Automata in construction of parsers.
CO5	Recognize the power of actual computers and analyse classes of P, NP, NP-C and NP-Hard problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Introduction to Automata (mathematical model of digital devices including real computer) for computation, State Transition Graph, Finite Automaton (FA) and its types, Deterministic Finite Automaton (DFA), Non-deterministic Finite Automaton (NDFA), Complement, Union, Intersection of FA's , Conversion Strategy from NDFA to DFA , Minimization of FA, Finite Automaton with	**06**

Output, Applications of FA	
Module – II: REGULAR EXPRESSION (RE): R.E.'s and basic operations, Algebraic laws on Regular Expression, Finite and Infinite Languages, Equivalence of finite Automaton and regular expressions, Constructing NDFA from Regular Expression , Pumping Lemma for Regular Language, Closure properties of Regular Languages, Non-regular languages, Applications of Regular Expression	**10**
Module – III: Introduction, Formal Definition of Grammar, The Chomsky Hierarchy of Grammar, Designing Regular grammar from DFA, Context Free Grammar, Closure properties of Context Free Languages, CFG and Normal form: Chomsky Normal Form, Greibach Normal Form, Non-Context Free Language, Applications of CFGs	**08**
Module – IV: PUSHDOWN AUTOMATON (PDA): Introduction, Definition of PDA, Types of Pushdown Automata (DPDA and NPDA), Converting CFG to PDA, Derivation (Parsing), Parsing Techniques, Ambiguous and Unambiguous Grammar, Demerits of Ambiguous Grammar	**10**
Module – V:TURING MACHINE(TM): Single Tape TM, Variations of TM, Halting Problem, Turing Machine and Languages, Enumerable Languages, Decidable, Undecidable languages, Introduction to classes of Problems: P, NP, NP-C and NP-Hard	**6**

TEXTBOOKS: 1. Hopcroft J.E., Motwani R. and Ullman J.D, *Introduction to Automata Theory, Languages and Computations*, Second Edition, Pearson Education, 2008.

REFERENCE BOOKS:

1. K.L.P. Mishra and N. Chandrasekaran, *Theory of Computer Science: Automata, Languages and Computation*, 3rd Edition, PHI

2. John C Martin, *Introduction to Languages and the Theory of Computation*, Third Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.

3. Harry R. Lewis and Christos H. Papadimitriou, *Elements of the theory of Computation*, Second Edition, Prentice-Hall of India Pvt. Ltd.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50

Continuous Internal Assessment	% Distribution

Assignment / Quiz (s)	10+10
Teacher's Assesment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects
CD5	Expert talks
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course / Outcomes	Program outcomes (PO)												Program specific outcomes (PSO)		
CS24219	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
CO2	3	1	1	1	1	0	1	2	2	1	1	2	3	3	2
CO3	2	1	0	2	2	0	1	2	2	1	1	1	3	3	2
CO4	3	2	0	1	2	0	0	0	0	0	0	0	0	0	0
CO5	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO2	Lecture by use of boards/LCD projectors/OHP

	Projectors, Tutorials/Assignments
CO3	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO4	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO5	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments

COURSE INFORMATION SHEET

Course Code: CS24353
Course Title: Software Engineering
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B.Tech
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	To understand and apply knowledge of software process models and software project management practices
2.	To appropriately capture and document software requirement effectively utilize software requirement engineering practices.
3.	To provide robust technical design solution for software requirement.
4.	To deploy mechanism for quality software production.
5.	To use quantitative aspects of software production and to apply knowledge of software evolution.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Apply knowledge of software process models and software project management practices for software development
CO2	Analyze and Create software requirements specification document.
CO3	Provide robust technical design solution for software requirement.
CO4	Design test cases and use testing techniques and methodologies for quality software development.

CO5	Solve problems related software estimation, maintenance and configuration

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction Some Definitions, FAQs about software engineering, the evolving role of software, Software process models, Waterfall model, the prototyping model, spiral model, RAD and Incremental model, Agile models. Management activities, Project planning and Project Scheduling, Risk management.	**8**
Module – II Software Requirements Functional and non-functional requirements, User requirements, System requirements, the software requirements document. IEEE standard of SRS, Quality of good SRS. Requirement Engineering Process: Feasibility study, Requirements elicitation and analysis, Requirements validation, Requirement management	**8**
Module – III Design Engineering ,Design Process and Design Quality, Design Concepts, Design Models, Object oriented Design, Concept of cohesion and coupling. UML: Use case diagram, Class diagram, Activity diagram, Sequence diagram, Collaboration diagram	**8**
Module – IV Verification and Validation, Verification and Validation Planning, S/W inspection, static analysis. Software Testing, Testing functions, Test care design, White Box testing, Black box testing, Basis Path Testing, Control Structure Testing, Unit testing, Integration Testing, System testing, Reliability.	**8**
Module – V Process metrics, Software Measurement, Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, COCOMO, Function points, Quality assurance and standards, Quality planning, Quality control, Configuration management.S/W Maintenance in detail. Software Re-engineering.	**8**

TEXTBOOKS: Sommerville, Software Engineering, 7th Edition, Pearson Education Publication.
Mall Rajib, Fundamental of Software Engineering, 4th Edition, PHI Learning Private Limited.

REFERENCE BOOKS:

Pressman R. S.,Software Engineering: A Practiioners Approach, 5th Edition., TMA, New Delhi.(R1)
Peters J. F. &Pedrycz W., Software Engineering, John Wiley & Sons, Inc. 2000.(R3)
Behforooz A. & Hudson F.J., Software Engineering Fundamentals, Oxford Univ. Press,New York, 2000.(R4)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) NA

POS MET THROUGH GAPS IN THE SYLLABUS :NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments	
CD3	Laboratory experiments/Teaching aids/Seminars	
CD4	Mini Projects	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	1	1	1	2	2	2	1	1
CO2	2	2	2	1	1	2	1	2	2	2	1	2	1	1	2
CO3	3	3	1	3	3	3	2	1	1	1	2	1	1	1	2
CO4	2	1	2	1	1	1	1	1	1	1	1	1	1	2	1
CO5	3	2	1	2	3	1	1	1	1	2	1	1	1	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6

CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course Code: CS24361
Course Title: Information Retrieval
Pre-requisite(s): Data Structure and Algorithm
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: BTech
Semester / Level:
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	To provide the foundation knowledge in information retrieval
2.	To learn how data is pre-processed, and indexed for fast and accurate information retrieval.
3.	To equip students with sound skills to solve computational search problems
4.	To explore techniques for measuring the effectiveness and relevance of search engine results.
5.	To provide a foundational understanding of language modeling approaches in information retrieval.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

1.	Understand the basic concepts of information retrieval
2.	Apply efficient techniques for the indexing of documents
3.	Design and develop information retrieval systems
4.	Perform the evaluation and critical analysis of the performance of the retrieval system
5.	Describe the principles of language modeling in IR

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)

Module – I: Introduction: Introduction; Search Engine Architecture; An overview of crawling, text transformation, index creation, user interaction, ranking, link analysis, evaluation and deep web.	**6**
Module – II: Pre-processing and Indexing Pre-processing: tokenization, stop word, normalization, stemming, wildcard queries, spelling correction – edit distance and k-gram; Indexing: Index construction; Index compression.	**12**
Module – III: Scoring Parametric and zone indexes; term frequency and weighting; vector space model; efficient scoring and ranking; page ranking algorithms.	**8**
Module – IV: IR Evaluation and Query Expansion Evaluation; Standard test collection; Evaluation of unranked and ranked retrieval; Assessing relevance; System quality and user utility, Query Expansion and Relevance Feedback	**8**
Module – V: Language Model for Information Retrieval Language Models; The query likelihood model; Language modeling versus other approaches in IR; Extended language modeling approaches	**6**

Text book:

Manning, Christopher D., Raghavan Prabhakar, and SchützeHinrich, "Introduction to Information Retrieval", Cambridge: Cambridge University Press, 2008.(T1)

Reference books:

Grossman David A., Frieder Ophir "Information Retrieval: Algorithms and Heuristics", Springer.(R1)

Croft Bruce, Metzler Donald, and Strohman Trevor "Search Engines: Information Retrieval in Practice", Pearson Education, 2009.(R2)

Ricardo Baeza-Yates and Neto Berthier Ribeiro "Modern Information Retrieval", 2nd Edition, Addison-Wesley, 2011.(R3)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
	25
	50

Continuous Internal Assessment	% Distribution

	10+10
	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

C D1	Lecture by use of boards/LCD projectors/OHP
C D2	Projectors
C D3	Tutorials/Assignments
C D4	Seminars
C D5	Mini projects
C D6	Expert talks
C D7	Self- learning such as use of NPTEL materials and

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	2	3	3	3	2	2	1	1	2	2	1	2	3	3	2
CO2	3	3	2	3	3	2	2	1	3	2	1	1	2	3	3
CO3	3	3	3	3	3	2	2	2	3	2	3	2	3	2	3
CO4	3	3	3	2	2	3	3	1	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	3	2	1	1	2	2	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	Lecture by use of boards/LCD

	projectors/OHP Projectors, Tutorials/Assignments
CO2	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO3	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO4	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO5	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments

COURSE INFORMATION SHEET

Course Code: CS24362
Course Title: Information Retrieval Lab
Pre-requisite(s): Data Structure and Algorithm
Co- requisite(s):
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class:
Semester / Level:
Branch: AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

●	To introduce foundational concepts and algorithms in web crawling and data scraping for information retrieval.
●	To equip students with preprocessing techniques and indexing strategies for efficient text retrieval.
●	To explore ranking functions and link analysis for enhancing retrieval relevance and page importance.
●	To evaluate information retrieval systems using standard performance metrics and query expansion methods.
●	To introduce language modeling techniques for advanced retrieval and comparison with classical IR approaches.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Develop web crawlers and analyze their performance.
CO2	Apply text preprocessing and indexing techniques for efficient document retrieval.
CO3	Implement ranking algorithms like TF-IDF, Cosine Similarity, and PageRank for IR systems.
CO4	Evaluate IR systems using precision, recall, and implement query expansion techniques like Rocchio algorithm.
CO5	Design and compare traditional IR methods with language modeling approaches for enhanced retrieval.

SYLLABUS

MODULE	(NO. OF Labs)
Module – I Web Scrapping and Crawling **6. Implement different web crawling algorithms and compare their performance and behavior.** **7. Target a website to scrap data to develop a particular Information Retrieval System.**	**2**
Module – II Text Preprocessing and Index creation (Either Scrapped data or offline data) **8. Apply text preprocessing techniques: tokenization, stop word removal, stemming, and lemmatization.** **9. Create an incidence matrix, analyze its size, and perform Boolean queries for document retrieval.** **10. Build an inverted index using various data structures (dictionary, B-Tree, hash map) and analyze their efficiency.** **11. Implement merge algorithms and their extensions (e.g., skipping pointers, DAAT, TAAT) for efficient query processing.** **12. Create index using BSBI (Blocked Sort-Based Indexing) and SPIMI (Single-Pass In-Memory Indexing) techniques.** **13. Implement phrase queries using positional indexes to support ordered and adjacent term matching.** **14. Implement Levenshtein distance and bigram indexing techniques to handle spelling errors and support approximate string matching.**	**4**
Module – III: Scoring **7. Implement different ranking functions (Cosine Similarity, RSV, BM25) using the TF-IDF weighting scheme and compare their accuracy.** **8. Implement a PageRank algorithm to evaluate the importance of web pages based on link structure.**	**2**
Module – IV: IR evaluation and Query Expansion **4. Implement different evaluation techniques for both unranked and ranked retrieval systems to assess performance.** **5. Implement the Rocchio algorithm for query reformulation and analyze its impact on retrieval effectiveness.**	**1**
Module – V: Language Model for Information Retrieval **7. Implement language models for Information Retrieval, including the query likelihood model, and compare them with traditional IR approaches; explore extended language modeling techniques for improved retrieval performance.**	**1**

TEXTBOOKS:

Textbook:

Manning, Christopher D., Raghavan Prabhakar, and SchützeHinrich, "Introduction to Information Retrieval", Cambridge: Cambridge University Press, 2008.(T1)

Text book:

Manning, Christopher D., Raghavan Prabhakar, and SchützeHinrich, "Introduction to Information Retrieval", Cambridge: Cambridge University Press, 2008.(T1)

Reference books:

Grossman David A., Frieder Ophir "Information Retrieval: Algorithms and Heuristics", Springer.(R1)

Croft Bruce, Metzler Donald, and Strohman Trevor "Search Engines: Information Retrieval in Practice", Pearson Education, 2009.(R2)

Ricardo Baeza-Yates and Neto Berthier Ribeiro "Modern Information Retrieval", 2nd Edition, Addison-Wesley, 2011.(R3)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

7. **Student Feedback on Course Outcome**

8. **Student Feedback on Faculty/Content Delivery**
9. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	2	3	3	3	2	2	1	1	2	2	1	2	3	3	2
CO2	3	3	2	3	3	2	2	1	3	2	1	1	2	3	3
CO3	3	3	3	3	3	2	2	2	3	2	3	2	3	2	3
CO4	3	3	3	2	2	3	3	1	2	2	2	2	3	3	2
CO5	3	2	2	3	3	2	3	2	1	1	2	2	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	**Course Delivery Method**
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: AI24361

Course Title: Evolutionary Computing
Pre-requisite(s):
Co- requisite(s):
Credits: L:3 T: 0 P: 0
Class schedule per week: 3
Class:
Semester / Level:
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

●	Understand the concept of Evolutionary algorithms and its variants
●	Deep knowledge of Crossover and Mutation Operators.
●	Apply different Selection Schemes according to problem specifications
●	Dealing with Constraint Handling Techniques
●	Use Constraint Handling Techniques on complex problems.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Understand the foundation, its variants and application of Evolutionary Algorithms
CO2	Classify and Apply Crossover and Mutation Operators
CO3	Design and Apply different Selection Schemes
CO4	Implement suitable Constraint Handling Techniques
CO5	Solve complex problems dealing with Multi-Objective Optimization

SYLLABUS

Module 1: Introduction and Principles of Evolutionary Computation (EC) [8 Lectures]
Introduction and Principles of Evolutionary Computation (EC): Introduction to Optimization, Generalized Formulation, Scope of Optimization via Applications, Characteristics of Optimization Functions; Biological and artificial evolution, Evolutionary computation and AI, Different historical branches of EC, e.g., GAs, EP, ES, GP, etc. A simple evolutionary algorithm, Advantages and Limitations of EC

Module 2: Crossover & Mutation Operators [8 Lectures]
Recombination/Crossover for strings (e.g., binary strings), e.g., one-point, multi-point, and uniform crossover operators, Whole arithmetic Recombination, Mutation for strings, e.g., bit-flipping, Recombination/Crossover and mutation rates, Recombination for real-valued representations, e.g., discrete and intermediate recombination, Mutation for real-valued representations.

Module 3: Selection Schemes [8 Lectures]
Fitness–Proportionate Selection with "Roulette Wheel" and "Stochastic Universal" Sampling, Boltzmann Selection, Rank Selection, Tournament Selection, Selection pressure and its impact on evolutionary search, Steady–State Selection, Elitism: Age based and Fitness based, Termination, Evolutionary Combinatorial Optimization, Evolutionary algorithms for TSPs,

Module 4: Constraint Handling Techniques	**[8 Lectures]**
Generalized Constraint Formulation, Common techniques, e.g., penalty methods, repair methods Karush Kuhn Tucker (KKT) conditions, Penalty Function Method, Parameter-Less Deb's Method, Graphical Examples, Case studies	

Module 5: Introduction to Multi-Objective Optimization	**[8 Lectures]**
Introduction, Generalized Formulation, Concept of Dominance and Pareto-optimality, Graphical Examples, Terminologies, Difference with Single-objective optimization, Approaches to multi-objective optimization, Hybrid evolutionary and local search algorithms,	

TEXTBOOKS:

8. Goldberg D E, "Genetic Algorithms in search", Optimization and machine learning, Addison-Wesley 2005.

Reference Books:

15. *An Introduction to Genetic Algorithms*, Melanie Mitchell, MIT Press, 1996.
16. K. Deb, Multi-objective Optimization using Evolutionary Algorithms, Wiley, 2001.
17. Carlos Coello Coello, Gary B. Lamont, David A. van Veldhuizen, Evolutionary Algorithms for Solving Multi-Objective Problems, Springer, 2007

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	**% Distribution**
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

10. **Student Feedback on Course Outcome**
11. **Student Feedback on Faculty/Content Delivery**
12. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

COURSE DELIVERY METHODS

CD 1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD 2	Assignments/Seminars	√
CD 3	Laboratory experiments/teaching aids	
CD 4	Industrial/guest lectures	
CD 5	Industrial visits/in-plant training	
CD 6	Self- learning such as use of NPTEL materials and internets	√
CD 7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course Outcome	**Program Outcomes (POs)**												**Program Specific Outcomes(PSOs)**		
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	2	2	1	1	1	2	2	3	2	1
CO2	3	3	3	3	3	2	1	3	2	2	1	2	3	3	2
CO3	3	3	3	3	3	2	2	3	1	1	2	1	3	3	2
CO4	3	3	3	3	3	2	1	3	1	1	1	1	3	3	2
CO5	3	3	3	3	3	2	1	3	1	2	1	1	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	**Course Delivery Method**
CO1	CD1, CD2, CD3

CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: AI24362
Course Title: Evolutionary Computing Lab
Pre-requisite(s):
Co- requisite(s): AI24315 Evolutionary Computing
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class:
Semester / Level:
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

●	Understand the concept of Evolutionary algorithms and its variants
●	Deep knowledge of Crossover and Mutation Operators.
●	Apply different Selection Schemes according to problem specifications
●	Dealing with Constraint Handling Techniques
●	Use Constraint Handling Techniques on complex problems.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Write basic code for Evolutionary Algorithms
CO2	Develop Crossover and Mutation Operators
CO3	Design and Develop different Selection Schemes
CO4	Develop suitable Constraint Handling Techniques
CO5	Develop codes for complex problems dealing with Multi-Objective Optimization

SYLLABUS

MODULE	(NO. OF Labs)
Module – I **Programs based on simple Evolutionary Computation steps**.	**3**
Module – II **Programs based on to use Crossover & Mutation Operators to check the efficiencies for simple problems**.	**3**
Module – III **Programs based on applications of different Selection Schemes and track the performance. Solve Complex combinatorial problems.**	**2**
Module – IV **Programs with Constraint Handling requirements. Use penalty methods and**	**2**

KKT conditions.	
Module – V **Programs based on Multi-Objective Optimization and Hybrid evolutionary and local search algorithms.**	**3**

TEXTBOOK:

Applied Evolutionary Algorithms for Engineers Using Python by Leonardo Azevedo Scardua, CRC Press, 1st edition (15 June 2021); ISBN- 978-0367263133

REFERENCE BOOK:

Learning Genetic Algorithms with Python: Empower the Performance of Machine Learning and Artificial Intelligence Models with the Capabilities of a Powerful Search Algorithm by Ivan Gridin, BPB Publication

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

13. **Student Feedback on Course Outcome**
14. **Student Feedback on Faculty/Content Delivery**
15. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course/ Outcomes	**Program outcomes (PO)**												**Program specific outcomes (PSO)**		
CS24219	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	2	1	2	3	3	3	3	3	1
CO2	2	3	2	3	2	2	1	2	2	3	3	3	2	2	2
CO3	2	3	3	3	3	3	3	2	3	3	3	3	2	2	3
CO4	3	2	2	3	3	2	2	1	3	3	3	3	3	3	2
CO5	3	3	3	3	2	2	2	1	3	3	3	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	**Course Delivery Method**
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course code: **CS24365**
Course title: **Image Processing**
Pre-requisite(s): **Discrete Mathematics, Data Structures**
Co- requisite(s):
Credits: **L: 3 T:0 P: 0**
Class schedule per week: **3**
Class: **B. Tech**
Branch: **CSE/IT/AIML**

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

1.	Understand the concept of image formation, digitization, and role human visual system plays in perception of image data and spatial filtering techniques for enhancing the appearance of an image.
2.	Acquire an appreciation for various frequency-based filtering techniques for enhancing the appearance of an image, duly applying them in different applications.
3.	Discern the difference between noise models, gain an insight into assessing the degradation function and realize different spatial and frequency-based filtering techniques for reduction and removal of noise.
4.	Synthesize a solution to image compression using the concept of information theory and lossless and lossy compression techniques.
5.	Design and create practical solutions using morphological and image segmentation operators for common image processing problems and assess the results.

Module I **[8 Lectures]**
Introduction to Digital Image Processing, Elements of Visual Perception, Image Sensing & Acquisition, Sampling and Quantization, Basic Relationships between Pixels, Intensity Transformations, Histogram Processing, Spatial Convolution & Correlation, Smoothing Spatial Filters, Sharpening Spatial Filters.

Module II **[8 Lectures]**
Introduction to the Fourier Transform, Discrete Fourier Transform, Properties of the Two-Dimensional Fourier Transform, Image Smoothing using Frequency Domain filters, Image Sharpening using Frequency Domain filters, Selective Filtering, Basics of Fast Fourier Transform, Basics of: Walsh-Hadamard Transform; Discrete Cosine Transform.

Module III **[8 Lctures]**
Model of Image Degradation/Restoration Process, Noise Probability Density Functions, Restoration in presence of Noise only, Periodic Noise Reduction using Frequency Domain filtering, Circulant Matrices, Block Circulant Matrices, Unconstrained Restoration, Constrained Restoration, Basics of Inverse Filtering

Module IV **[8 Lectures]**
Image Compression Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria, Image Compression Models– Source Encoder and Decoder, Channel

Encoder and Decoder, Elements of Information Theory, Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding.

Module V **[8 Lectures]**
Morphological Image Processing- Preliminaries, Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformation Image Segmentation- Fundamentals, Point, Line and Edge Detection, Thresholding, Region Based Segmentation, Segmentation based on colour.

Text books:

- Rafael. C. Gonzalez & Richard E. Woods- Digital Image Processing, 4/e Pearson Education, New Delhi - 2009

Reference books:

- W.K.Pratt-Digital Image Processing, 4/e, John Wiley & sons, Inc. 2006.
- M. Sonka et al. Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007.
- Jayaraman, Digital Image Processing, Tata McGraw-Hill Education, 2011

Mapping Course Outcomes onto Program Outcomes

CO \ PO/PSO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO1	PSO 2	PSO 3
CO1	3	2	-	1	2	-	1	-	1	2	1	2	2	2	1
CO2	3	3	2	2	3	1	1	-	1	2	1	2	3	2	2
CO3	3	3	2	3	3	1	1	-	1	2	1	3	3	3	2
CO4	3	3	2	2	3	2	2	1	2	2	2	3	3	3	3
CO5	3	3	2	2	3	2	2	1	2	2	2	3	3	3	3

Justifications by Outcome Category

Programme Outcomes (PO)

- PO1–PO2 (Knowledge & Analysis): All COs draw upon engineering knowledge and analytical thinking in processing and analyzing images.
- PO3 (Design/Development): CO2–CO5 involve designing filters, workflows, and processing pipelines.
- PO4 (Investigations): CO3, CO4, and CO5 deal with interpreting noise models, restoration, and segmentation results.
- PO5 (Modern Tools): Practical use of tools like MATLAB/OpenCV and Python libraries is integral across COs.
- PO6–PO7 (Society/Environment): CO4 and CO5 involve efficient compression and segmentation which are key for medical/remote sensing/social applications.
- PO8 (Ethics): CO4 and CO5 include fair and ethical use of visual data and compression in surveillance and medical fields.
- PO9–PO11 (Teamwork/Management/Communication): Indirectly supported via projects and

presentations as part of labs or assignments.

- PO12 (Life-long Learning): All COs encourage understanding foundational concepts useful in advanced CV, AI, ML applications.

Programme Specific Outcomes (PSO)

4. PSO1 (ML/AI/Data): Strongly tied to almost every CO, especially CO2–CO5.
5. PSO2 (Research/Projects): Restoration, segmentation, and compression modules are essential for research work.
6. PSO3 (Societal Perspective): Ethical, efficient, and sustainable aspects of image handling are taught across CO4–CO5.

COURSE INFORMATION SHEET

Course code: **CS24366**

Course title: **Image Processing Lab**
Pre-requisite(s): **CS24102 : PPS Lab & CS24202 : Data Structures Lab**
Co- requisite(s): **Image Processing**
Credits: **L: 3 T:0 P: 0**
Class schedule per week: **3**
Class: **B. Tech**
Branch: **CSE/IT/AIML**

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

1.	Implement and evaluate image enhancement techniques in both spatial and frequency domains.
2.	Apply noise reduction and restoration techniques to improve image quality.
3.	Develop and implement image compression algorithms, both lossless and lossy, and assess their efficiency.
4.	Apply segmentation methods for feature extraction in images and implement thresholding, edge detection, and region-based segmentation techniques.
5.	Gain proficiency in using image processing software/tools (MATLAB, Python, OpenCV) for developing and testing image processing algorithms.

Module I
Introduction and Image Enhancement: Basic image reading, writing, and display operations, Visualization of image histograms, Intensity transformations: contrast stretching, negative, logarithmic, and power law. Histogram equalization and specification for contrast enhancement.

Module II
Spatial and Frequency Domain Filtering: Convolution and correlation using smoothing (average, Gaussian) and sharpening (Laplacian, Sobel) filters. Implementation of 2D Fourier Transform and its inverse. Frequency domain filtering: Ideal, Butterworth, Gaussian. Noise addition and filtering in frequency domain.

Module III
Image Restoration and Compression: Simulating image degradation (motion blur, Gaussian blur). Restoration techniques: Inverse and Wiener filtering. Compression using Run-Length Encoding and Huffman Coding (lossless). JPEG-style lossy compression using DCT and quantization.

Module IV
Morphological Image Processing: Binary morphological operations: dilation, erosion, opening, closing. Connected component labeling.

Module V

Image Segmentation and Feature Extraction: Thresholding: global, adaptive. Edge detection: Sobel, Prewitt, Canny. Region growing and region splitting merging. Feature extraction: shape descriptors, object labeling.

List of Experiments

Module I: Image Fundamentals & Spatial Domain Processing

16. Image Sampling and Quantization
    Simulate image sampling at different resolutions and quantization levels.
    Analyze perceptual loss vs file size.
17. Intensity Transformations
    Implement contrast stretching, logarithmic, and power-law transformations.
    Apply to X-ray or satellite images to enhance features.
18. Histogram Analysis and Equalization
    Perform standard and adaptive histogram equalization (CLAHE).
    Compare their effect on low-contrast images.
19. Spatial Filtering using Convolution and Correlation
    Apply custom filters using 2D convolution and correlation.
    Explore noise removal vs edge enhancement.

Module II: Frequency Domain & Transform-Based Processing

9. 2D DFT and Frequency Spectrum Visualization
    Compute and display magnitude and phase spectrum.
    Mask specific frequencies and reconstruct the image.
10. Design and Apply Frequency Domain Filters
    Implement ideal, Gaussian, and Butterworth filters.
    Compare their performance on noisy images.
11. Image Sharpening via High-Frequency Emphasis Filtering
    Enhance details by combining high-pass filtered image with original.
12. Transform Coding for Compression
    Apply DCT and Walsh Transform to compress images.
    Evaluate reconstructed image quality via PSNR.

Module III: Image Restoration

8. Noise Simulation and Denoising
    Inject Gaussian, salt-and-pepper, speckle noise.
    Apply mean, median, and adaptive filters.
9. Image Restoration using Inverse and Wiener Filtering
    Restore a motion-blurred image using inverse filter.
    Compare with Wiener filter for noisy-blurred images.
10. Periodic Noise Removal using Notch Filters
    Detect and suppress periodic noise in frequency domain.
11. Image Restoration with Constrained Least Squares
    Implement constrained restoration techniques on degraded images.

Module IV: Image Compression

9. Implement Huffman and Run-Length Encoding
    Apply lossless compression techniques to grayscale images.
    Plot code efficiency and compression ratio.
10. Lossy Predictive and Transform-Based Compression
    Predict next pixel and encode residuals (DPCM).
    Use DCT to compress and reconstruct with minimal loss.

Module V: Morphological Processing & Segmentation

18. Morphological Operations on Binary Images
    Erosion, dilation, opening, closing, boundary extraction.
    Apply on text images or scanned maps.
19. Segmentation using Clustering (K-Means, Fuzzy C-Means)
    Segment RGB images based on color similarity.

Visualize and evaluate segmentation accuracy.

Text books:

- Rafael. C. Gonzalez & Richard E. Woods- Digital Image Processing, 4/e Pearson Education, New Delhi - 2009

Reference books:

- W.K.Pratt-Digital Image Processing, 4/e, John Wiley & sons, Inc. 2006.
- M. Sonka et al. Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007.
- Jayaraman, Digital Image Processing, Tata McGraw-Hill Education, 2011

Mapping Course Outcomes onto Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	-	-	-	-	2	-	2	3	2	-
CO2	3	3	3	2	3	1	-	0	-	2	-	2	3	3	1
CO3	3	3	3	3	3	1	-	1	-	1	-	3	3	3	1
CO4	3	3	2	2	3	0	-	-	2	2	2	3	3	3	2
CO5	3	3	3	3	3	1	-	-	3	3	3	3	3	3	3

Justifications by Outcome Category

PO1 (Engineering Knowledge): Strong across all COs — foundational theory is directly applied in lab exercises.
PO2 (Problem Analysis): CO2 to CO5 demand critical thinking in noise removal, segmentation, compression.
PO3 (Design/Development): Strong in filter design, restoration tasks, segmentation logic (CO2–CO5).
PO4 (Investigation): CO3–CO5 involve experimentation and result interpretation using datasets.
PO5 (Modern Tool Usage): All COs use MATLAB/OpenCV/Python; mapped with high relevance.
PO6–PO8: Only marginal relevance (e.g., PO6, PO8 slightly mapped for ethical use and implications).
PO9 (Team Work): Collaborative mini-projects mapped in CO4 and CO5.
PO10 (Communication): CO1 and CO2 involve basic documentation and reporting.
PO11 (Project Management): CO4 and CO5 include timelines and structured reports.
PO12 (Life-long Learning): All COs reinforce adaptability to new tech.
PSO1 (ML/AI Real-world): Core purpose — pre-processing is key for ML tasks (e.g., object detection).
PSO2 (Project Development): All COs support stepwise development of mini-projects.
PSO3 (Societal aspects): Mapped only where solutions address real-world challenges (e.g., medical imaging, traffic analysis).

COURSE INFORMATION SHEET

Course Code: AI24371
Course Title: Introduction to Compiler Design
Pre-requisite(s): Data Structures, Basics of Automata theory (regular expressions, context free grammar), Computer architecture
Co- requisite(s): Nil
Credits: L: 3 T: 1 P: 0
Class schedule per week:
Class: B.TECH
Semester / Level: IV
Branch: Computer Sc. and Engg
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the need of compiler in Computer Engineering.
	Provide understanding of design, working, and implementation of programming Languages.
	Trace the major concept areas of language translation and compiler design.
	Create an awareness of the functioning and complexity of modern compilers

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Analyze the need of compiler for interfacing between user and machine.
CO2	Perceive the role of several phases of compilation process.
CO3	Write regular expressions and context free grammars for programming language features and construct deterministic scanners and parsers.
CO4	Design semantic analyzers and generate intermediate code with support for runtime environment.
CO5	Understand the machine independent optimizations that are performed by modern compilers.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Introduction to Compilers and its Cousins, Structure of a Compiler., Lexical Analyzer, Input Buffering, Specification and Recognition of Tokens. Construction of Deterministic Finite Automata directly from regular expression.	**06**
Module – II: Introduction to Syntax Analysis. Grammar rewriting transformations for parsing methods. Recursive and Non-Recursive Top-Down Parsers, design of LL(1) parser. Bottom-up Parsers: Variants of LR Parsers, handling of conflicts. Detection and reporting of syntax errors.	**10**
Module – III: Introduction to Semantic analysis. Syntax-Directed Definition (SDD) and Syntax-Directed Translation Schemes (SDTS). SDTS for declaration processing. Three Address Code. Concepts of types of attributes for semantic analysis. Type checking for expressions and generation of intermediate code for assignment statement. Translation of multi-dimensional array references.	**10**

Module – IV: Complete and Partial Evaluation of Boolean expressions and Translation of control flow constructs. Resolution of forward and backward jumps in the intermediate code. Translation of function call and return, Memory layout of code and data, Activation record for implementation of function calls.	**08**
Module – V: Addresses of code and data in assembly code and correlate with the same in source code. Construction of Basic Blocks and Control Flow Graph. Illustration of Machine Independent Local and Global Optimizations, unreachable code, constant folding, constant propagation, loop invariant code motion, elimination of common expressions, removal of dead code.	**06**

Text Book:

1. Aho A. V., Lam M. S., Sethi R., Ullman J. D., Compilers, Principles, Techniques, and Tool, 2nd Edition, Pearson Education Asia.

Reference Books:

1. Fischer C. N., LeBlanc R. J., Crafting a Compiler with C, Pearson Education Asia.
2. Louden K. C., Compiler Construction, Principles and Practice, Thomson, Brooks/Cole.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination Marks	25
End Sem Examination Marks	50

Continuous Internal Assessment	% Distribution
Assignment / Quiz (s)	10+10
Teacher's Assesment	05

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP

	Projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects
CD5	Expert talks
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course / Outcomes	**Program outcomes (PO)**												**Program specific outcomes (PSO)**		
CS24219	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	0	2	0	0	0	0	0	0	0	1	0	0
CO2	2	1	1	1	1	0	1	2	2	1	1	2	2	1	1
CO3	2	1	0	0	2	0	1	2	2	1	1	1	1	1	1
CO4	1	1	0	1	2	0	0	0	0	0	0	0	0	0	0
CO5	1	1	0	0	1	0	0	0	0	0	0	0	1	1	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	**Course Delivery Method**
CO1	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO2	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO3	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO4	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments
CO5	Lecture by use of boards/LCD projectors/OHP Projectors, Tutorials/Assignments

COURSE INFORMATION SHEET

Course Code: AI24373
Course Title: Statistical Machine Learning
Pre-requisite(s): Basic Probability, Linear Algebra, Basic Machine Learning

Co- requisite(s): NIL
Credits: L: 3 T: 3 P: 0
Class schedule per week: 3
Class: BTech
Semester / Level:
Branch: AI & ML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

●	Understand fundamental concepts of probability, statistics and inference.
●	To apply statistical methods in machine learning models.
●	To analyze uncertainty and make decisions based on probabilistic frameworks.
●	To design machine learning systems with statistical rigor.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Understand and apply probability distributions and statistical inference techniques.
CO2	Derive and apply maximum likelihood and Bayesian parameter estimation methods.
CO3	Model supervised and unsupervised learning problems problematically.
CO4	Implement Expectation-Maximization and Gaussian Mixture Models.
CO5	Apply Bayesian reasoning and decision theory in ML systems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Review of Probability Theory, Bayes' Theorem, Random variable, probability distribution, Joint and Marginal distribution, Correlation and covariance, Applications in machine learning**	**8**
Module – II **Sampling and Estimation, Maximum Likelihood Estimation (MLE), Hypothesis testing, t-test, z-test, Chi-square test, ANNOVA, Confidence interval, Bayesian Estimatiom**	**8**
Module – III **Regression Models, Generalized Linear Models (GLMs), Logistic Regression Cross-validation, Naïve Bayes Classifier, Gaussian Discriminant Analysis (GDA) Linear Discriminant Analysis (LDA) and Quadratic Discriminant Analysis (QDA); Bias-Variance Decomposition**	**8**
Module – IV	

Introduction to Unsupervised Learning, Gaussian Mixture Models (GMMs) for soft clustering approaches, Expectation-Maximization (EM) Algorithm, Latent Variable Models, Principal Component Analysis (PCA), Factor Analysis for low-dimensional representation of data, Hidden Markov Models (HMMs).	**8**
Module – V **Bayesian Decision Theory, Bayesian Linear Regression, Bayesian Logistic Regression with approximation techniques; Variational Inference methods including Evidence Lower Bound (ELBO) and Mean Field Approximation, Markov Chain Monte Carlo (MCMC), Bayesian non-parametric model; Probabilistic Deep Learning and Bayesian Neural Networks**	**8**

TEXTBOOKS:

- **Bishop, C. M. Pattern Recognition and Machine Learning. Springer, 2006. First Edition**
- **Murphy, K. P. Machine Learning: A Probabilistic Perspective. MIT Press, 2012. First Edition.**

REFERENCE BOOKS:

- **Barber, D. Bayesian Reasoning and Machine Learning. Cambridge University Press, 2012. First Edition.**

2. Hastie, T., Tibshirani, R., and Friedman, J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. 2nd ed., Springer, 2009.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) NA

POS MET THROUGH GAPS IN THE SYLLABUS NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Internal Assessment	50%
End Semester Examination	50%

Continuous Internal Assessment	% Distribution
Quizzes/Assignments	2x10% = 20%
Mid Semeter Examination	25%
Teacher's Assessment	5%

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

Student feedback on CO Attainment

CD1	Lecture through chalk and talk
CD2	Lecture through presentations
CD3	Tutorials/Assignments
CD4	Problem solving sessions
CD5	Case studies/Applications
CD6	Group discussion/Quizzes
CD7	Self-study/Research-based Learning

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3
CO 1	**3**	**3**	**2**	**2**	**2**	**1**	**0**	**1**	**0**	**2**	**0**	**2**	**3**	**2**	**1**
CO 2	**3**	**3**	**2**	**2**	**2**	**1**	**0**	**1**	**0**	**2**	**0**	**2**	**3**	**2**	**1**
CO 3	**3**	**2**	**3**	**3**	**2**	**1**	**0**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO 4	**3**	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO 5	**3**	**2**	**2**	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**2**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2
CO2	CD1, CD3
CO3	CD2, CD4
CO4	CD2, CD5
CO5	CD3, CD6

COURSE INFORMATION SHEET

Course Code: AI24375
Course Title: Pattern Recognition
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: P:

Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Be familiar with both the theoretical and practical aspects Pattern Recognition.
	Describe the foundation of pattern formation, measurement, and analysis.
	Understand the mathematical and computer aspects while extracting features of an object.
	Learn the techniques of clustering and classification for various applications.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Apply knowledge on converting Real World Problems computer compatible problems for Pattern Recognition.
CO2	Solve Decision making model using Statistical and Mathematical Decision Theory.
CO3	Design clusters for various Pattern using classical and Modern clustering techniques.
CO4	Analyzing various Techniques for Pattern Classification and Clustering.
CO5	Develop Model for Pattern classification through Probabilistic or fuzzy techniques.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction: Feature Vectors, Classifiers, Supervised, Unsupervised, MATLAB Tools. Classifiers Based on Bayesian Theory, Linear Classifiers, Nonlinear Classifiers.	**9**
Module – II Feature Selection, Feature Generation I: Data Transformation and Dimensionality Reduction, Feature Generation II.	**9**
Module – III Template Matching, Context Dependent Classification, Supervised Learning	**9**
Module – IV Clustering: Basic Concepts, sequential Algorithms.	**6**

Module – V Hierarchical algorithms, Fuzzy clustering, probabilistic clustering, Hard Clustering, Optimization.	**7**

TEXTBOOKS:

- Theodoridis S., Koutroumbas K., Elsevier, "Pattern Recognition", 5th Edition 2015.(T1)
- Murty N. Narshima "Pattern Recognition", Springer, University Press2nd edition,2015.(T2)

REFERENCE BOOKS:

DudaR.O.,Hart E. Peter,Stork G. David," Pattern Classification" 2nd Edition, John Wiley, New York, 2002.(R1)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Paper based Exam	85
Computer based Exam	15

Continuous Internal Assessment	% Distribution
Quiz-I	10
Assessment	10
Assignment	05
Mid-Semester	25

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

7. **Student Feedback on Course Outcome**
8. **Student Feedback on Faculty/Content Delivery**
9. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self-Learning, Group Study, Coding Contest

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5, CD7
CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course code: CS24453
Course title: Computer Vision
Pre-requisite(s): Image Processing, CS24313 Machine Learning
Co- requisite(s):

Credits: L: 3 T:0 P: 0
Class schedule per week: 3
Class: B. Tech
Branch: CSE/IT/AIML

Course Outcomes

After the completion of this course, students will be able to:

1.	Understand the principles of image formation, filtering, and edge detection.
2.	Apply techniques for detecting and describing visual features in images.
3.	Analyze geometric relationships between images for object tracking and 3D reconstruction.
4.	Implement classification and detection models for object and scene recognition.
5.	Utilize modern vision algorithms in practical applications involving faces, gestures, and motion analysis.

Module I Introduction and Image Formation [8 Lectures]

Introduction to Computer Vision, Applications, Human and Computer Vision, Pinhole Camera Model, Perspective Projection, Radiometry, Photometric Image Formation, Camera Calibration and Distortion

Module II Image Processing and Feature Detection [8 Lectures]

Image Filtering: Gaussian, Median, Bilateral, Edge Detection: Sobel, Canny Interest Point Detection: Harris, FAST, Feature Description: SIFT, SURF, ORB Feature Matching and RANSAC

Module III Multiple Views and Motion [8 Lectures]

Epipolar Geometry and Fundamental Matrix, Stereo Vision and Depth Estimation, Structure from Motion (SfM), Optical Flow and Motion Estimation, Camera Pose Estimation (PnP)

Module IV Recognition and Classification [8 Lectures]

Image Classification: Bag of Visual Words, HOG, Object Detection: Haar Cascades, YOLO Basics, Deep Learning in Vision: CNNs Overview, Transfer Learning in Vision Models

Module V Advanced Topics and Applications [8 Lectures]

Face Detection and Recognition, Scene Understanding and Segmentation, Gesture and Action Recognition, Visual SLAM and Autonomous Navigation, Applications: AR, Robotics, Healthcare, Surveillance

Text books:

13. Richard Szeliski, *Computer Vision: Algorithms and Applications*,2nd Edition (2022), Springer

Reference books:

- **Richard Hartley and Andrew Zisserman, *Multiple View Geometry in Computer Vision*.** 2nd Edition, Cambridge University Press
- **Scott Krig,** Computer Vision Metrics: Survey, Taxonomy, and Analysis**,** Apress, 2014
- **David Forsyth and Jean Ponce,** Computer Vision: A Modern Approach, Pearson India, 2015.

Mapping Course Outcomes onto Program Outcomes

Co\ PO/ PSOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	-	-	-	-	2	3	2	-
CO2	3	3	3	2	3	-	-	-	1	-	-	2	3	3	1
CO3	2	3	3	2	3	1	-	1	2	2	2	3	3	3	2
CO4	3	3	3	3	2	-	-	-	1	1	-	2	2	3	2
CO5	2	2	3	2	3	2	2	2	1	2	2	3	3	3	3

Justifications by Outcome Category

PO/PSO Justification

PO1 Core mathematical and computational principles are used throughout the vision pipeline (filtering, transforms, learning algorithms).

PO2 Students analyze complex vision problems like object detection, segmentation, etc. using research-based solutions.

PO3 Design of vision systems for autonomous navigation, surveillance, and healthcare imaging requires creative problem-solving.

PO4 Lab work and projects involve experimentation with datasets, model testing, and performance evaluation.

PO5 Use of tools like OpenCV, TensorFlow, PyTorch for vision development links this CO to modern tool usage.

PO6 Real-world applications (e.g., surveillance, medical imaging) require understanding societal and safety aspects.

PO7 Ethical AI in vision (e.g., bias, facial recognition) is tied to sustainable and responsible design.

PO8 Students are encouraged to reflect on ethical issues in surveillance, privacy, and automation.

PO9 Team-based mini projects foster collaboration and role distribution among students.

PO10 Students must present project findings and reports, thus practicing technical communication.

PO11 Mini-project planning and model deployment foster project management awareness.

PO12 Vision is a fast-evolving field, and students learn to keep up with new techniques via self-study and MOOCs.

PSO1 Core application of AI/ML to vision tasks such as detection, segmentation, classification.

PSO2 Students build vision models and systems in mini-projects and research-inspired assignments.

PSO3 Emphasis on ethical, cultural, and societal implications in real-world deployments (e.g., security, medical).

COURSE INFORMATION SHEET

Course code: CS24454
Course title: Computer Vision Lab
Pre-requisite(s): Image Processing Lab & CS24314: Machine Learning Lab

Co- requisite(s): Computer Vision
Credits: L: 3 T:0 P: 0
Class schedule per week: 3
Class: B. Tech
Branch: CSE/IT/AIML

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

1.	Implement and visualize key image processing and feature extraction techniques.
2.	Design and experiment with object detection, tracking, and motion estimation techniques.
3.	Apply stereo vision, camera calibration, and 3D reconstruction techniques.
4.	Evaluate deep learning-based object recognition, classification, and segmentation models.
5.	Build a mini-project integrating multiple CV components for a real-world use case.

Module I
Foundations of Image Processing and Feature Detection
Experiment 1: Implement edge detection using Canny and Sobel operators.
Experiment 2: Image gradient analysis using filters and visualizations.
Experiment 3: Feature detection using Harris and SIFT/SURF.
Experiment 4: Image alignment using key point matching.

Module II
Object Detection and Motion Estimation
Experiment 5: Implement object tracking using optical flow (Lucas-Kanade/Farneback).
Experiment 6: Background subtraction in videos for moving object detection.
Experiment 7: YOLO or SSD implementation on real-time video streams.
Experiment 8: Object detection using HOG+SVM.

Module III
Image Restoration and Compression: Simulating image degradation (motion blur, Gaussian blur). Restoration techniques: Inverse and Wiener filtering. Compression using Run-Length Encoding and Huffman Coding (lossless). JPEG-style lossy compression using DCT and quantization.

Module IV Deep Learning in Computer Vision
Experiment 13: Image classification using pretrained CNNs (ResNet/VGG).
Experiment 14: Object detection using pre-trained YOLOv5 or EfficientDet.
Experiment 15: Semantic segmentation using U-Net or DeepLabV3+.
Experiment 16: Train a small custom dataset with transfer learning

Module V Project and Evaluation
Experiment 17: Mini-project (e.g., pedestrian detection, pose estimation, sign recognition).
Experiment 18: Testing, and validation with performance metrics.

Text books:

11. Richard Szeliski, *Computer Vision: Algorithms and Applications*,2nd Edition (2022), Springer

Reference books:

- **Richard Hartley and Andrew Zisserman, *Multiple View Geometry in Computer Vision*.** 2nd Edition, Cambridge University Press
- **Scott Krig,** Computer Vision Metrics: Survey, Taxonomy, and Analysis**,** Apress, 2014
- **David Forsyth and Jean Ponce,** Computer Vision: A Modern Approach, Pearson India, 2015.

Mapping Course Outcomes onto Program Outcomes

CO\ PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	-	-	1	-	-	2	3	2	-
CO2	2	3	3	2	3	-	-	1	2	1	1	2	3	3	1
CO3	2	3	3	3	3	1	-	-	1	1	1	2	3	3	2
CO4	2	3	3	3	3	1	1	1	1	2	2	3	3	3	3
CO5	2	2	3	3	3	2	2	2	3	2	2	3	3	3	3

Justifications by Outcome Category

PO/PSO Justification

PO1 Use of mathematical foundations in calibration, motion estimation, and learning-based models.

PO2 Students analyze problems like depth estimation, recognition, and design appropriate solutions.

PO3 Implementation of real-world CV pipelines requires designing efficient and feasible solutions.

PO4 Evaluation of performance, training models, and analyzing data through experimentation.

PO5 Use of tools like OpenCV, PyTorch, TensorFlow supports modern engineering tool usage.

PO6-PO8 Real-world problems (e.g., facial recognition, surveillance) include ethical and social impact.

PO9 Mini-projects and team tasks promote team work and communication.

PO10 Report writing and project presentations improve technical communication.

PO11 End-to-end CV project management enhances this skill.

PO12 Students are encouraged to learn new libraries, tools, and models.

PSO1 Strong alignment with AI and ML applied to visual data.

PSO2 Emphasis on applied and research-based problem-solving.

PSO3 Application of CV in health, safety, mobility—all with social relevance.

COURSE INFORMATION SHEET

Course Code: CS24455
Course Title: Internet of Things(IoT)
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B.Tech
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the basic concept and the IoT Paradigm
	Know the state of art architecture for IoT applications
	Learn the available protocols used for IoT
	Design basic IoT Applications.
	Evaluate optimal IoT applications

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Identify the IoT Components and its capabilities
CO2	Explain the architectural view of IoT under real world constraints
CO3	Analyse the different Network and link layer protocols
CO4	Evaluate and choose among the transport layer protocols
CO5	Design an IoT application

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to IOT Fundamentals, definition, main assumptions and perspectives. Platform for IoT devices, Device architectures, Power Sources and management, Operating systems for resource-constrained devices	**8**
Module – II Architecture of IOT Node structure: Sensing, Processing, Communication, Powering IOT networking: Topologies, Layer/Stack architecture, ETSI IoT M2M Architecture, IoT ARM, data link layer for IoT.	**8**
Module – III Communication Technologies	**8**

Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Basics of WSN and MANET Networks	
Module – IV M2M and IoT Technology Fundamentals M2M Devices and gateways, Local and wide area networking, Application layer Protocols like Service oriented protocols (COAP). Communication protocols based on the exchange of messages (MQTT). Service discovery protocols. TCP and MPTCP Protocols.	**8**
Module – V The data processing for IoT Organization of data processing for the Internet of things. Cloud computing. Fog computing. Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.	**8**

TEXTBOOKS: Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.

Raj Pethuru and Raman Anupama C., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.

REFERENCE BOOKS:

Vermesan Dr. Ovidiu, Friess Dr. Peter, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers.

Holler Jan, TsiatsisVlasios, Mulligan Catherine, Avesand Stefan, Karnouskos Stamatis, Boyle David, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) NA

POS MET THROUGH GAPS IN THE SYLLABUS :NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20 (2×10)
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments	
CD3	Laboratory experiments/Teaching aids/Seminars	
CD4	Mini Projects	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	1	2	1	2	1	1	2	2	2	2
CO2	2	3	3	3	2	2	1	1	1	1	1	2	2	3	2
CO3	2	3	2	2	2	1	1	1	1	1	1	2	3	2	2
CO4	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2
CO5	2	3	3	3	2	1	1	2	1	1	1	3	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

COURSE INFORMATION SHEET

Course Code: CS24456
Course Title: Internet of Things(IoT) Lab
Pre-requisite(s):
Co- requisite(s):
Credits: L: T: 0 P: 3
Class schedule per week: 3
Class: B.Tech
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the basic concept and the IoT Paradigm
	Know the state of art architecture for IoT applications
	Learn the available protocols used for IoT
	Design basic IoT Applications.
	Evaluate optimal IoT applications

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Configure Micro Controller , Sensing devices to develop IoT applications
CO2	Design minor applications using Leds,DHT,IR Sensors etc.
CO3	Configure Cloud with IoT devices for Analytics
CO4	Design and develop real time smart applications
CO5	Analyze various protocols for IoT applications

Syllabus: Introduction to Microcontrollers, Sensors, Pyhton Programming,ThinkSpeak,AWS Cloud Implementation of Protocols like MQTT etc.

TEXTBOOKS: Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.

Raj Pethuru and Raman Anupama C., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.

REFERENCE BOOKS:

Vermesan Dr. Ovidiu, Friess Dr. Peter, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers.

Holler Jan, TsiatsisVlasios, Mulligan Catherine, Avesand Stefan, Karnouskos Stamatis, Boyle David, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) NA

POS MET THROUGH GAPS IN THE SYLLABUS :NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN :NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	% Distribution
Day to Day Evaluation	30
Viva	20
Quiz1	10
End Sem(Performance Test)+Quiz2	30+10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course	Course Delivery Method

Outcomes	
CO1	CD1,CD6
CO2	CD1, CD6,CD7
CO3	CD1, CD2, CD3,CD6,CD7
CO4	CD1, CD3,CD6,CD7
CO5	CD1,CD2,CD3,CD4,CD5,CD7

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	1	2	1	2	1	1	2	2	2	2
CO2	2	3	3	3	2	2	1	1	1	1	1	2	2	3	2
CO3	2	3	2	2	2	1	1	1	1	1	1	2	3	2	2
CO4	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2
CO5	2	3	3	3	2	1	1	2	1	1	1	3	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

COURSE INFORMATION SHEET

Course Code: AI24457
Course Title: Distributed Systems
Pre-requisite(s): Operating System, DCCN
Co- requisite(s): NA
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B.Tech.
Semester / Level: 7
Branch: AIML
Name of Teacher: Amritanjali

COURSE OBJECTIVES

This course envisions to impart to students to:

	Knowledge of the fundamental concepts and principles of distributed systems.
	Learn inter-process communication and coordination mechanisms.
	Learn usage of distributed resources, handling security and fault-tolerance issues.
	Analytical skills to understand and solve real world applications of distributed systems.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Demonstrate understanding of key concepts of distributed systems
CO2	Design client-server and peer-to-peer systems.
CO3	Analyze inter-process communications, and coordination mechanisms.
CO4	Evaluate fault tolerance, recovery, and security in distributed environments.
CO5	Analyze and solve real world challenges in implementing distributed applications

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Distributed Systems** Definition & Examples of Distributed Systems, Design goals **Architectural Styles**: Layered architecture, Service-oriented architecture, Publish-subscribe architecture, Middleware organization, Client-Server and Peer-to-Peer System Models.	**8**
Module – II **Processes and Communication** **Processes**: Threads, Virtualization, Code migration. **Communication:** Interprocess communication (IPC), Message-oriented communication (synchronous/asynchronous), RPC, RMI, Message queuing systems, Stream-oriented communication, Multicast protocols.	**8**
Module – III **Coordination and Naming**	**8**

Coordination: Clock synchronization, Logical clocks, Mutual Exclusion, Election Algorithms. **Naming**: Flat naming, Structured naming, Attribute-based naming	
Module – IV **Consistency, Replication & Fault Tolerance** **Consistency & Replication**: Data-centric consistency models, Client-centric models, Replication management and Consistency protocols. **Fault Tolerance**: Fault models, Reliable client-server communication, Recovery & checkpointing	**8**
Module – V **Distributed File Systems and Security** **Security**: Cryptography basics, Authentication, Authorization and Monitoring. **Distributed File System**: File service architecture, Stateless/Stateful servers, Case studies.	**8**

TEXTBOOKS:

20. Distributed Systems: Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, Pearson Education, 4th Edition

REFERENCE BOOKS:

14. Distributed Systems: Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Pearson Education, 5th Edition.
15. Designing Data-Intensive Applications, Martin Kleppmann, O'Reilly Media, 2nd Edition.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment

Continuous Internal Assessment	% Distribution

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	
CD2	
CD3	
CD4	
CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**2**	**2**	**1**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO2	**3**	**2**	**3**	**2**	**1**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO3	**3**	**3**	**3**	**3**	**3**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO4	**3**	**3**	**3**	**3**	**3**	**1**	**1**		**2**	**2**	**2**	**3**	**2**	**2**	**1**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**1**		**2**	**2**	**2**	**3**	**3**	**2**	**1**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	
CO2	

CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: AI24458
Course Title: Distributed Systems Lab
Pre-requisite(s): Operating System, DCCN
Co- requisite(s): NA
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B.Tech.
Semester / Level: 7
Branch: AIML
Name of Teacher: Amritanjali

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the fundamental concepts and principles of distributed systems through practical exposure
	Apply inter-process communication, mutual exclusion, and synchronization mechanisms
	Experiment with distributed resources, scalability and fault-tolerance.
	Use modern tools and frameworks for developing and deploying distributed applications

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Demonstrate understanding of key concepts of distributed systems
CO2	Implement client-server and peer-to-peer models
CO3	Apply algorithms for logical clocks, mutual exclusion, and leader election
CO4	Utilize containerization and orchestration tools to simulate distributed environments
CO5	Analyze and solve real world challenges in implementing distributed applications

SYLLABUS

Programs on following topics:

- Setting distributed nodes using dockers
- Event-ordering based on logical clocks
- Time synchronization across distributed processes using Cristian's and Berkeley's algorithms
- Shared access synchronization using token-ring mutual exclusion algorithm
- Distributed communication using gRPC remote procedure call
- Simple multicasting and reliable multicasting
- Message Queues and publisher-subscriber communication models
- Election algorithms
- Replication
- Use of Apache Zookeeper for coordination service

TEXTBOOKS:

10. Designing Data-Intensive Applications, Martin Kleppmann, O'Reilly Media, 2nd Edition

REFERENCE BOOKS:

11. Distributed Systems: Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, Pearson Education, 4th Edition

12. Distributed Systems: Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Pearson Education, 5th Edition

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment

Continuous Internal Assessment	% Distribution

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment					
Semester End Examination					

INDIRECT ASSESSMENT

- **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

C D1	
C D2	
C D3	
C D4	
C D5	
C D6	

C D7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO 1	**3**	**2**	**2**	**2**	**1**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO 2	**3**	**2**	**3**	**2**	**1**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO 3	**3**	**3**	**3**	**3**	**2**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO 4	**3**	**3**	**3**	**3**	**3**	**1**	**1**		**2**	**2**	**2**	**2**	**2**	**2**	**1**
CO 5	**3**	**3**	**3**	**3**	**3**	**2**	**1**		**2**	**2**	**2**	**3**	**2**	**2**	**1**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: CS24459
Course Title: Optimization Technique
Pre-requisite(s):
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the basics of Optimization Models.
	Learn the basic concepts of Linear and Dynamic Programming.
	Understand the principles of Nonlinear Programming.
	Know about the basics of Heuristic Programming.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Prepare the operational models for the real-world applications using Linear Programming
CO2	Apply the techniques to solve the Network Optimization models
CO3	Analyze the computational feasibility of the solutions using the Deterministic and Probabilistic Dynamic Programming
CO4	Model problems using Non-Linear Programming and evaluate the suitability of the available techniques for the problem at hand
CO5	Apply the meta-heuristic algorithms for real world optimization problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Linear Programming,Solving Linear Programming Problems – Graphical Method,The Simplex Method,The Revised Simplex Method, Duality Theory , Dual Simplex Method, Sensitivity Analysis.	**9**
Module – II Integer Programming,Gomory's Cutting Plane Method, The Branch-and-Bound Technique for Binary and Mixed-Integer programming. Network Optimization Models, The Network Simplex Method.	**8**
Module – III Dynamic Programming: Characteristics of Dynamic Programming	**8**

Problem,Deterministic Dynamic Programming, Probabilistic Dynamic Programming.	
Module – IV Nonlinear Programming: Graphical Illustration of Nonlinear Programming Problems, Types of Nonlinear Programming Problems, Unconstrained Optimization, The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization, Quadratic Programming, Separable Programming, Convex Programming.	**9**
Module – V Queueing Theory : Basic Structure of Queueing Models, Examples of Real Queueing Systems, Role of Exponential Distribution, The Birth-and-Death Process, Different Queuing Models.Heuristic Programming and Metaheuristics: The Nature of Meta-Heuristics, Search, Simulated Annealing, Genetic Algorithms.	**6**

TEXTBOOKS:

Hiller ,S. & Lieberman ,G.J.,"Operations Research", 9/e , TMH, New Delhi–2012.

REFERENCE BOOKS:

- Taha ,H.A.,"Operations Research", 9/e , Pearson Education , New Delhi-2013.
- Pai,P.P.,"Operations Research", 1/e, Oxford University Press 2012.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Paper based Exam	85
Computer based Exam	15

Continuous Internal Assessment	% Distribution
Quiz-I	10
Assessment	10
Assignment	05
Mid-Semester	25

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]
Semester End Examination	20%[10]	20%[10]	20%[10]	20%[10]	20%[10]

INDIRECT ASSESSMENT

12. **Student Feedback on Course Outcome**
13. **Student Feedback on Faculty/Content Delivery**
14. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Self-Learning, Group Study, Coding Contest

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**2**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5, CD7
CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course Code: CS24460
Course Title: Optimization Technique LAB
Pre-requisite(s):

Co- requisite(s):
Credits: L: 0 T: 0 P: 3
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Translate complex scenarios into mathematical optimization problems
	Understand different Optimization Techniques
	Implement Optimization Algorithms and interpret results and analyze performance
	Model Objective functions of the Optimization Problems

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Formulate and solve Optimization Problems
CO2	Apply critical thinking and problem-solving skills on Optimization Problems
CO3	Develop Programs for Optimization Algorithm
CO4	Develop Proficiency using software tools
CO5	Apply their knowledge to solve problems in engineering, business, science, and other fields

SYLLABUS

MODULE	(NO. OF LABS)
Module – I **Programs based on Linear Programming Formulation, graphical methods**	**2**
Module – II **Programs based on simplex method, duality, and sensitivity analysis.**	**3**
Module – III **Programs Based on Non-Linear Programming,**	**3**
Module – IV **Programs based on Network Analysis, Inventory Models**	**2**
Module – V **Programs based on Dynamic Programming, Decision Theory, Queuing Systems**	**3**

TEXTBOOKS:

Various software packages are used to implement OR models and techniques:

13. **Excel Solver: A built-in optimization tool in Microsoft Excel.**
14.
15. **OR-Tools (Google's open-source software suite): A collection of algorithms and tools for solving combinatorial optimization problems, including vehicle routing, flows, and constraint programming**

REFERENCE BOOKS:

CPLEX, Gurobi, AMPL: Commercial optimization solvers.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

21. **Student Feedback on Course Outcome**

22. **Student Feedback on Faculty/Content Delivery**
23. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**1**	**2**	**1**	**1**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**2**	**1**	**1**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**1**	**0**	**0**	**1**	**2**	**1**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**0**	**0**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO5	**3**	**2**	**2**	**1**	**2**	**2**	**0**	**0**	**1**	**2**	**2**	**2**	**3**	**3**	**3**

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: AI24471
Course Title: Speech Processing
Pre-requisite(s):

Co-requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class:
BTECH
Semester / Level: VII
Branch: AIML

Course Objectives

This course envisions to impart students to:

1	To understand speech production and the human auditory system and different speech signal processing techniques.
2	To understand the fundamentals of speech production, its perception, and inherent features.
3	Develop an ability to evaluate the pattern comparison and design issues of speech recognition.
4	To understand the basics of LPC and its variants for various applications
5	Develop and apply speech processing technology for different real life applications.

Course Outcomes

After the completion of this course, students will be able to:

CO1	Understand the basics of speech production, its perception, and auditory models.
CO2	Understand the feature representation and various techniques involved in collecting the features from the speech signal in both the time and frequency domain
CO3	Analyze various components of parameter estimation and feature representations of speech signals.
CO4	Analyze the speech processing, its implementation, and properties of the speech signal.
CO5	Develop an ability to create and apply speech-processing techniques in various applications in different areas.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction- Human Auditory System; Speech production mechanism, Classification of speech, sounds, nature of speech signal, models of speech production, purpose of speech processing, Digital processing of speech signals. Approaches to automatic speech recognition by machine.	**8**
Module – II Speech Analysis- Time domain parameters of speech, Zero crossing, Auto correlation function, Pitch period estimation, short time Fourier analysis, Filter bank analysis, spectrographic analysis, formant extraction, pitch extraction.	**8**
Module – III Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals, Levinson-Durbin algorithm, Auto correlation method, Covariance method, LPC model of speech production, speech perception features	**8**
Module – IV Classification techniques- Elements of vector quantization implementation, The VQ training Set, the similarity or distance measure, Clustering the training vectors, Vector classification procedure, Comparison of vector and scalar quantizers, HMM, GMM	**8**
Module – V Application of speech processing- Speech recognition applications, Broad classes of Speech-Recognition, speaker recognition, Speech synthesis, speech coding,	**8**

Text Books:

- L.R. Rabiner, B. H. Juang and B. Yegnanarayana, "Fundamentals of Speech Recognition", Pearson, Education

Reference Books:

1. L.R. Rabiner and R.E Schafer, Digital processing of speech signals, Pearson Education Inc..
2. A. M. Kondoz, "Digital Speech", Second Edition (Wiley Students Edition), 2004.
3. W. C. Chu, "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", Wiley Inter science, 2003.

Topics beyond syllabus/Advanced topics/Design

Teaching through Research paper

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure

Direct Assessment:

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	**% Distribution**
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment:

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

Course Delivery Methods:

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects

CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes:

Course Outcome	Program Outcomes (POs)												Program Specifi Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	1	2	1	1	1	1	2	3	2	3	2
CO2	3	3	3	3	3	1	1	1	1	1	2	2	3	3	2
CO3	3	3	2	3	3	1	1	1	1	1	2	3	3	2	3
CO4	3	3	3	2	3	1	1	3	2	1	2	3	3	2	3
CO5	2	3	3	3	3	3	2	3	3	3	3	3	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

Mapping Between Course Outcomes and Course Delivery Methods

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD2, CD3, CD6,
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD7

COURSE INFORMATION SHEET

Course Code: CS24475
Course Title: Cryptography and Network Security
Pre-requisite(s): Data Communication and Computer Network
Co- requisite(s):
Credits: L: T: P:
Class schedule per week:
Class: B.Tech
Semester / Level:
Branch: CSE and AIML

COURSE OBJECTIVES

This course envisions to impart to students to:

	To Learn Basic Concepts of Cryptography and Network Security and Apply them in various Real-life Application.
	To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
	To understand how to deploy encryption techniques to transmit a message over an insecure channel by various means.
	To design security applications in the field of Information technology
	To understand various protocols for network security to protect against the threats in the networks.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Understand the basic concept of Cryptography and Network Security and to be familiar with different types of threats.
CO2	Learning and applying various Symmetric key cryptography algorithms for confidentiality.
CO3	Learning and applying various Asymmetric key cryptography algorithms and Standards in Networks.
CO4	Learning and applying various Authentication functions and services for integrity and authentication
CO5	Examine the issues and structure of Authentication Service and Electronic Mail Security and provide familiarity in Intrusion detection and Firewall Design Principles.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Introduction to Cryptography Principles of Security, The Need for Security, Security Services, Mechanisms and	**10**

Attacks, The OSI Security Architecture, A Model for Network Security. Classical Encryption Techniques, Cryptanalysis, Steganography.	
Module – II: Symmetric Key Cryptography Symmetric key cryptography, Stream Cipher, Block Cipher Principles, Block Cipher Modes of Operation. The Data Encryption Standard Algorithm (DES), Differential and Linear Cryptanalysis, Triple DES, IDEA, AES	**8**
Module – III: Asymmetric Key Cryptography Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, RSA Cryptosystem, Elgamal Cryptosystem, Elliptic Curve Cryptosystems, Symmetric and Asymmetric Key Cryptography Together, Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates	**6**
Module – IV: Authentication Authentication Functions, Message Authentication Codes, Hash Functions, HMAC, Public Key Infrastructure, Digital Signatures Standards, Digital Certificate, Kerberos, One-way Authentication, Mutual Authentication, Remote User-Authentication Principles and Techniques, Remote User-Authentication Using Symmetric Encryption, Remote User Authentication Using Asymmetric Encryption.	**8**
Module – V: Internet Security Transport Layer Security (TLS), Hyper Text Transfer Protocol Secure (HTTPS), Time stamping Protocol (TSP), Secure Electronic Transaction (SET), PGP, S/MIME, Security Issues in TCP/IP and DNS, DNSSec, IP Security.	**8**

TEXTBOOKS:

- Stallings W., "Cryptography and Network Security: Principles and Practice", 7th Edition, Pearson, 2017.

REFERENCE BOOKS:

16. Forouzan B. A., "Cryptography and Network Security", 3rd Edition, Mcgraw Higher Education, 2016.
17. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.
18. Kahate A., "Crptography and Network Security", 3rd Edition, McGraw Hill Education, New Delhi, 2013.
19. Schneier B., "Applied Cryptogaphy: Protocols, Algorithms And Source Code In C", 2nd Edition, Wiley, 2007.
20. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
21. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.

Course Outcome (CO) Attainment Assessment Tools and Evaluation Procedure Direct Assessment:

Assessment Tools	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	50
Quiz	20
Assignment	20
Teacher's Assessment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment:

1. Student Feedback on Faculty

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CO1	3	3	2	2	2	2	2	1	2	2	2	3	2	3	3
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CO3	3	3	2	3	3	2	1	1	1	1	2	3	3	2	3
CO4	3	3	3	2	3	1	1	3	2	2	2	3	3	2	3
CO5	2	3	3	3	3	3	2	3	3	3	3	3	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

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