BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK

(Effective from Academic Session: Monsoon 2024)

B.TECH IN COMPUTER SCIENCE & ENGINEERING

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 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	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	PS O 1	PS O 2	PS O 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	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: 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.	**8**

Understanding break and continue and their usage. Writing Nested loops, Arrays – creation and usage, Strings and string handling.	
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

	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**	**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,**	**3**

selection logic including nested selection logic switch structures.	
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.

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	**10**

Stack: basic operations using Array and LL, Queue: basic operations using Array and LL, Circular Queue and Variants of Queue, Stack and Queue 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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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**
Module – IV	**3**

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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
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) Instruction Set Architecture : Memory Locations and Addresses, Byte Addressability,	**8**

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: CS24203
Course Title: Mathematics for Computer Science
Pre-requisite(s): Algebra and Basic of Calculus
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:

COURSE OBJECTIVES

This course envisions to impart the students to:

	Reason mathematically about basic data types and structures in computer algorithms and systems.
	Synthesize key mathematical concepts such as functions, polynomials, combinatorics, probability, linear algebra, number theory, and inequalities.
	Understand mathematical applications in computing, such as graph theory in networks, linear algebra in graphics, and probability in AI.
	Enhance analytical thinking and reasoning skills necessary for algorithm design and computational problem-solving
	Apply mathematical techniques in areas like cryptography, machine learning, and optimization.

COURSE OUTCOMES (COs)

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

CO1	Apply the concepts of functions, polynomials and logic gates to solve computational problems.
CO2	Use combinatorics and probability to analyze algorithms and optimize computational processes.
CO3	Exert and apply the various mathematical foundations of Cryptography.
CO4	Employ linear algebra techniques in areas such as computer graphics, machine learning, and Markov processes.
CO5	Use special inequalities and optimization techniques for machine learning, data analysis, and performance tuning of algorithms.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Functions and Logic **Functions:** Introduction, Types of Functions, Growth of Functions, Polynomials, Operations on Polynomials. **Boolean Algebra:** Logic Gates, Simplification using Karnaugh Maps.	**6**

Module – II: Combinatorics and Probability **Probability and Random Variables:** Introduction to Counting Techniques, Random Variables, Discrete Random Variable, Entropy Calculation, Probability Mass Function, Continuous Random Variable, Probability Density Function, Cumulative Distribution Function, Conditional Probability, Bayes' Theorem, Expectation, Probability Distributions: Discrete and Continuous, Markov Chains, Describing Datasets, Summarizing Datasets.	**8**
Module – III: Number Theory and Foundations of Cryptography **Introduction to Number Theory:** Divisibility, The Greatest Common Divisor, Modular Arithmetic, Prime Numbers, Multiplicative Inverses, Fermat's and Euler's Theorem, Remainder Arithmetic, Linear and Quadratic Congruence, Discrete Logarithms. **Finite Fields:** Groups, Rings, Fields, Finite Fields of the Form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2^n).	**8**
Module – IV: Linear Algebra and Matrices **Vector Spaces and Matrices:** Field, Vector and Vector Space (Linear Dependence and Independence, Basis Vectors and Dimension), Hilbert Space, Orthogonality, Norms, Matrices and Matrix Operations, Determinants, Rank and Inverse of Matrices, Eigenvalues and Eigenvectors, Applications in PageRank and Facial Recognition, Matrix Factorization using Eigenvalue and Eigen-Space, Eigen Value Decomposition, Jacobian and Hessians Matrix.	**10**
Module – V: Some Special Inequalities and Optimization **Inequalities:** Introduction, Chebyshev's Inequality, Selberg's Inequality, Jensen's Inequality, Cauchy–Schwarz Inequality, Kraft's Inequality. **Optimization:** Lagrange Multipliers, Convex Optimization, Applications in Machine Learning.	**8**

TEXTBOOKS:

- Eric Lehman, F. Thomson Leighton, and Albert R. Meyer, "Mathematics for Computer Science", Cambridge, Massachusetts: Massachusetts Institute of Technology, 2010.

REFERENCE BOOKS:

- Kenneth H. Rosen, and Kamala Krithivasan, "Discrete Mathematics and its Applications", Vol. 6, New York: McGraw-Hill, 1999.
- Gilbert Strang, "Linear Algebra and its Applications", Cengage Learning, 2006.
- Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6th Edition, Academic Press, 2021.
- Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, McGraw Higher Education, 2016.
- B. J. Venkatachala, "Inequalities: An Approach through Problems", Vol. 49, Springer, 2018.

- Pablo Pedregal, “Introduction to Optimization”, Vol. 46, New York: Springer, 2004.

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

CO 3	3	3	3	3	2	1	0	0	0	2	0	3	3	3	1
CO 4	3	3	3	3	2	1	0	0	0	2	0	3	3	3	1
CO 5	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: 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: CS24204
Course Title: IT Workshop
Pre-requisite(s): COA, programming, Statistics
Co- requisite(s): COA, Statistics, Software Engineering basics, Simulation
Credits: 2.5 L: 0 T: 1 P: 3
Class schedule per week: 1
Class: BTech
Semester / Level:
Branch: CS/AIML
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

Understand and be able to apply assembly programming concepts using modern architectures like 64-bit X86.

	To understand the fundamental techniques of Natural language processing
	Gain comprehensive knowledge of software testing techniques and implement different testing methodologies.
	Explore and analyze the architectural features of CPUs and memory systems using simulators like Multi2Sim.
	Apply statistical techniques to perform descriptive and inferential analysis on datasets.
	Implement information retrieval methods on unstructured data using statistical approaches.

COURSE OUTCOMES (COs)

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

CO1	Demonstrate proficiency in writing and debugging assembly programs for 64-bit X86 architecture.
CO2	Apply software testing techniques to design and execute effective test cases using black-box and white-box methods.
CO3	Perform CPU and memory system analysis using simulation tools to understand performance characteristics.
CO4	Conduct descriptive and inferential statistical analysis to extract insights from datasets.
CO5	Develop and implement information retrieval systems using statistical methods to analyze unstructured data.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Assembly programming for contemporary architecture, such as the 64-bit X86 architecture	**2**
Module – II	**2**

Software testing - basics of testing; how testing works; types of testing - unit level, integration, system, acceptance, and regression testing; test cases; test data selection techniques; black box and white box	
Module – III Explore architectural features of CPU devices, memory systems, and perform performance analysis; multi2sim is one possible simulator.	**2**
Module – IV Experiments on selected topics related to statistics: Descriptive and Inferential Statistics	**2**
Module – V Information Retrieval on Unstructured Data using Statistical Methods	**2**

TEXTBOOKS:

5. **J. Bartlett, Programming from the Ground Up, Bartlett Publishing, 2004.**
6. **S. Desikan and G. Ramesh, Software Testing: Principles and Practices, Pearson Education, 2006.**
7. **J. L. Hennessy and D. A. Patterson, Computer Architecture: A Quantitative Approach, 6th ed., Morgan Kaufmann Publishers, 2017.**
8. **W. Navidi, Statistics for Engineers and Scientists, 5th ed., McGraw-Hill Education, 2020.**
9. **C. D. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008.**

REFERENCE BOOKS:

10. **D. Kusswurm, Modern X86 Assembly Language Programming, Apress (Springer Nature), 2018.**
11. **R. Black, E. van Veenendaal, and D. Graham, Foundations of Software Testing: ISTQB Certification, Cengage Learning, 2012.**
12. **D. A. Patterson and J. L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th ed., Morgan Kaufmann Publishers, 2017.**
13. **D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, 7th ed., Wiley, 2020.**
14. **S. Büttcher, C. L. A. Clarke, and G. V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 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
	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

	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
CO 1	2	1	3	2	3	1					1	2	2	2	2
CO 2	2	1	3	2	3	1				2	1	2	2	2	2
CO 3	2	2	3	2	3	1				2	2	2	2	2	3

CO 4	2	3	3	2	3	1	2	2	2	2	2	2	2	2	3
CO 5	3	2	3	1	2	2	2	2	2	2	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	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: 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

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

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:

1. Operating Systems: Internals and Design Principles, W. Stallings, 7th Edition, Pearson publication
2. 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: CS24219
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: 1 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	**06**

Strategy from NDFA to DFA , Minimization of FA, Finite Automaton with 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: 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	**5**

Lagrange's interpolation, Newton's divided differences interpolation formulas, Interpolating polynomial using Newton forward and backward differences.	
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: 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 Exceptions, rethrowing exceptions. File Handling: FileReader, FileWriter, BufferedReader, BufferedWriter, Serialization & Deserialization	**2**
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**
CO	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**

2															
CO 3	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**
CO 4	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**2**	**2**
CO 5	**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: CS24216
Course Title: Shell and Kernel Programming
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	**3**

daemons	
Module IV: Kernel Programming 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	**2**
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:

3. Operating System Concepts by Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 10th Edition, Wiley publication.
4. 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

14. 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: CS24301
Course Title: 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: 0 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: CS24302
Course Title: Compiler Design Lab.
Pre-requisite(s): Data Structures Laboratory, Shell and Kernel Programming Laboratory
Co- requisite(s): Nil
Credits: L: 0 T: 0 P: 3
Class schedule per week:
Class: B.TECH
Semester / Level: IV
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the structure and functioning of a compiler through hands on experience.
2	Learn two nontrivial software tools, Lex and Yacc, for use in compiler design and for other pattern recognition applications.
3	Design translators from a high level language to an intermediate language.
4	Possess a sound knowledge of the internals of modern compilers and their capability.

COURSE OUTCOMES (COs)

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

CO1	Perform experiments with an open source compiler, such as gcc, and exhibit insight about the various options provided by a compiler and its internal pass structure.
CO2	Acquire skills in the use of the tool Lex, to write regular expressions for programming language elements, attach actions to the expressions to generate a lexical analyser and examine its performance.
CO3	Write context free grammars to specify various program structures, such as declarations, expressions, statements and functions and use the tool YACC to generate a syntax analyser and to conduct experiments to evaluate its performance.
CO4	Design semantic analysers that perform analysis such as type checking and three address intermediate code generation by making use of effective communication the lexical and syntax analysers.

CO5	Generate and examine assembly code to identify the tasks performed by a compiler under run time environment and to understand through experimentation the machine independent optimizations that are performed by modern compilers.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Experiments on a production quality open source compiler to learn about the various options provided by the compiler to produce dumps of internal passes, generate assembly code without and with optimization on a contemporary architecture, such as 64-bit X86. Understand the translation process by comparing the source program with the outputs of a few passes and the assembly code. Examine the run time performance of the compiler generated executable code by running it over inputs of varying sizes with and without optimization. Generate a lexical analyser for identifying tokens and lexemes for the lexical elements in a high level language such as C. Learn the effect of ordering of regular expressions and the role played by the action routines.	3 Labs = 9L
Module – II: Write grammars to specify various syntactic structures of a program, such as declarations, ambiguous and unambiguous grammar for expressions, assignment statement, scalar variables and arrays in YACC. Conduct experiments with Lex and Yacc such that lex and yacc scripts are able to successfully communicate and generate a parser whose performance is to be evaluated through experimentation. Examine the LAR(1) parser generated by yacc and compare with a manual LALR(1) parser.	3 Labs = 9L
Module – III: Design semantic analysers using yacc. Semantic analysis to generate symbol table for declarations, three address intermediate code for assignment statement, complete and Partial Evaluation of Boolean expressions and translation of control flow constructs. Resolution of forward and backward jumps in the intermediate code.	3 Labs = 9L
Module – IV: Translation of function call and return, Memory layout of code and data, understand the compiler inserted code activation record for implementation of function calls	1 Lab.=3L
Module – V: Understand through experimentation of Machine Independent optimizations, such as unreachable code, constant folding, and constant propagation	1 Lab.=3L

Text Books:

Lex and Yacc, John R. Levine, Tony Mason, Doug Brown [1992], O'Reilly & Associates, 2nd Edition (ebook available)

References :

1. Lex and Yacc Tutorial, Tom Niemann, epaperpress.com, https: //cse.iitkgp.ac.in/ ~bivasm /notes /LexAndYaccTutorial.pdf
2. Johnson, Stephen C. [1975]. Yacc: Yet Another Compiler Compiler. Computing Science Technical Report No. 32, Bell Laboratories, Murray hill, New Jersey. A PDF version is available at ePaperPress.
3. 4. Lesk, M. E. and E. Schmidt [1975]. Lex – A Lexical Analyzer Generator. Computing Science Technical Report No. 39, Bell Laboratories, Murray Hill, New Jersey. A PDF version is available ePaperPress.

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
Progressive Evaluation	60
End Sem. Evaluation	40

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

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

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

Course/	Program outcomes (PO)	Program specific outcomes (PSO)

Outcomes															
CS24219	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	2	1	0	2	0	0	0	0	0	0	0	1	0	0
CO2	2	2	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	2	0	1	2	0	0	0	0	0	0	0	0	0	0
CO5	1	2	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	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

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	**8 Hrs.**

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	
Module – II Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.	**8 Hr.**
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	PO11	PO12	PSO1	PSO2	PSO3
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

COURSE INFORMATION SHEET

Course Code: CS24307

Course Title: Artificial Intelligence
Pre-requisite(s): NA
Co- requisite(s): NA
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: B. Tech
Semester / Level: V/III
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To understand Artificial intelligence, task of AI, history of AI, concept of agent, understand different types of environments, application of AI
	To understand the idea of search-based problem solving, state space search, heuristic search, hill climbing, simulated annealing, search in complex environment
	To understand how an agent can store and use knowledge to reason and make decision, basic principles of propositional logic, how to translate propositional into predicate logic, first order logic
	To build intelligent system that can make decision in presence of uncertainty, understand Bayesian network and Probabilistic reasoning
	To understand the fundamental concept of Machine learning

COURSE OUTCOMES (COs)

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

CO1	Determine problems that are amenable to AI-based solutions
CO2	State and apply major algorithms, methods, and theoretical results in the field of artificial intelligence, Illustrate uninformed and informed search techniques for problem solving in intelligent systems.
CO3	Understand and use different knowledge representation techniques enabling reasoning and inference in artificial intelligence-based systems
CO4	Formulate , solve planning problems, planning types, reason in environment, understand Bayesian Inference, and Probabilistic reasoning
CO5	Implement machine learning algorithms, train and evaluate models

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Preliminaries What is Artificial Intelligence (AI)? Evolution of AI, Intelligent Agents, Concept of rationality, Nature of environments, Structure of agents, Applications of AI	**6**
Module – II: Problem Solving by Search Agent Search based problem solving, State space search, Heuristic search, Local search, Search in complex environments, Game tree search.	**10**
Module – III : Knowledge Representation and Reasoning Knowledge based agents, propositional logic, propositional logic to predicate logic, propositional logic-based agents, First order predicate logic, Knowledge representation in First Order Logic, Forward chaining, Backward chaining, Inference	**8**

by resolution	
Module – IV: Planning and Probabilistic Reasoning Planning in AI, Components of a planning problem, Types of planning in AI, Goal stack planning, Reasoning under uncertainty, Bayesian Inference, Probabilistic reasoning	**8**
Module – V: Learning What is learning? Rote learning, Learning by taking advice, Learning from examples: Induction, Formal learning theory, Neural net learning, Underfitting and Overfitting.	**8**

TEXTBOOKS:

1. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.

REFERENCE BOOKS:

- Rich E. & Knight K., Artificial Intelligence, 3rd edition, TMH, New Delhi.
- Deepak Khemani, A First Course in Artificial Intelligence, Mc Graw Hill, First Edition, 2013.
- Sridhar and Vijayalakshmi, Machine Learning, Oxford University Press, First Edition, 2021

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
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Two quizzes	20(2X10)
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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
CO 1	3	2	2	2	2	2	2	1	1	1	2	2	2	2	1
CO 2	2	2	2	1	1	2	1	2	2	2	1	2	3	2	2
CO 3	3	3	1	3	3	3	2	1	1	1	2	1	3	2	2
CO 4	2	1	2	1	1	1	1	1	1	1	1	1	3	2	1
CO 5	3	2	1	2	3	1	1	1	1	2	1	1	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, CD7


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COURSE INFORMATION SHEET

Course Code: CS24308
Course Title: Artificial Intelligence Lab
Pre-requisite(s): Programming Language: Python (preferred)
Co- requisite(s): NA
Credits: 3 L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B. Tech
Semester / Level: V/III
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course enables the students:

	To implement and understand various AI agent types and environments, and to apply different search techniques used in intelligent systems
	To design and simulate knowledge-based systems using logic
	To implement planning, reasoning, and handle uncertainty in AI systems
	To explore learning techniques and apply them in building intelligent systems

COURSE OUTCOMES (COs)

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

CO1	Understand and implement the fundamentals of intelligent agents and environment interaction.
CO2	Apply various uninformed and informed search strategies to solve real-world problems
CO3	Design and implement knowledge representation systems using propositional and predicate logic for reasoning in AI
CO4	Design AI systems using planning, probabilistic reasoning, and learning models for intelligent decision-making
CO5	Integrate and apply multiple AI techniques to design and develop intelligent systems for solving real-world, complex problems

SYLLABUS

MODULE	(NO. OF Labs)
Module – I: Introduction to AI Tools and Python Libraries - Implement Reflex Agent in a simple environment (e.g., vacuum cleaner world) - Create a Goal-Based Agent to achieve predefined goals in a grid world, - Design a Utility-Based Agent with performance metrics - Compare agent behaviour in Fully Observable vs. Partially Observable environments using a custom simulation	**2**
Module – II: Search Algorithms Implement uninformed search, heuristic-based search and Local Search techniques. Build a Game Tree for a simple game (Tic-Tac-Toe) and implement Minimax Algorithm and enhance with Alpha-Beta pruning.	**3**
Module – III : Knowledge Representation and Reasoning Implementation of propositional and predicate logics and their applications in AI	**3**

agents	
Module – IV: Planning and Probabilistic Reasoning -Implement a simple planning algorithm (e.g., STRIPS-based planner). -Design an inference engine handling uncertainty using Bayesian Networks. -Model and reason with uncertain information (e.g., weather prediction, medical diagnosis).	**3**
Module – V: Learning -Implement supervised learning from examples using a classification model -Demonstrate underfitting and overfitting using training/test accuracy curves on datasets. -Develop a small AI application incorporating multiple modules. Examples: Smart Assistant using logic + learning, Simple AI for a board game, Decision support system	**4**

TEXTBOOKS:

1. Stuart Russell, Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall, Fourth edition, 2020.

REFERENCE BOOKS:

- Rich E. & Knight K., Artificial Intelligence, 3rd edition, TMH, New Delhi.
- Deepak Khemani, A First Course in Artificial Intelligence, Mc Graw Hill, First Edition, 2013.
- Sridhar and Vijayalakshmi, Machine Learning, Oxford University Press, First Edition, 2021

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
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	Distribution
Day-to-Day evaluation	30
One quizze	10
Lab Viva	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	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	2	1
CO2	2	2	2	1	1	2	1	2	2	2	1	2	3	2	2
CO3	3	3	1	3	3	3	2	1	1	1	2	1	3	2	2
CO4	2	1	2	1	1	1	1	1	1	1	1	1	3	2	1
CO5	3	2	2	2	3	1	1	1	1	2	1	1	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, CD7

COURSE INFORMATION SHEET

Course Code: CS24313
Course Title: Machine Learning
Pre-requisite(s): CS24303 Data Mining Concepts and Techniques
Co- requisite(s): CS24314 Machine Learning Lab
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3 L
Class: B.Tech.
Semester / Level: VI/ 3
Branch: Computer Science and Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To understand the basic concepts of learning techniques
	To explore the applications of machine learning
	To understand the concepts of supervised learning
	To explore the concepts of unsupervised learning
	To implement supervised and unsupervised learning in real-world applications.

COURSE OUTCOMES (COs)

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

CO1	Communicate a clear understanding of the core components of machine learning techniques.
CO2	Develop machine learning problems corresponding to different applications: data, model selection, model complexity.
CO3	Implement machine learning algorithms for supervised and unsupervised learning models on real -world datasets.
CO4	Evaluate and optimize ML models using performance metrics and validation techniques.
CO5	Apply machine learning solutions to address complex engineering and societal challenges.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Machine Learning and Types of Data Exploration Need of Machine Learning, Types, challenges and applications of Machine Learning, Univariate, Bivariate and Multivariate statistics, Essential statistics for multivariate data.	**6**
Module – II Basics Learning Theory and Similarity based Learning Learning and its types, Computation learning theory, Design of learning system, Representation of hypothesis, hypothesis space, Bias and Variance and their Tradeoff, Model selection and model evaluation, Resampling methods, Similarity based learning, difference between instance and model-based learning, Nearest Neighbor Learning.	**6**
Module – III Prediction and Classification Techniques	

Regression Analysis, Introduction to regression, linearity, correlation and causation, Linear Regression and its validation methods, Multiple Linear Regression, Logistic Linear Regression, Ridge, Lasso Regression. Decision Tree Learning Model, ID3, C4.5, CART models, Tree pruning and Validation.	**10**
Module – IV Support Vector Machine and Ensemble Learning Introduction to SVM, Optimal hyperplane, Hard Margin and Soft Margin SVM, Kernels and Non-Linear SVM Introduction to Ensemble techniques, Parallel EMs: Voting, Bootstrap, Bagging, Random Forest, Incremental EM, Stacking, Sequential EM, AdaBoost.	**10**
Module – V Clustering Algorithms Introduction to Clustering approaches, Proximity measures, Hierarchical Clustering algorithms, Single, Complete and Average Linkage algorithms, Mean shift clustering algorithms, Partitional clustering algorithms, K-Means, K-Medoid, Density based methods, DBSCAN algorithms, probability Model based methods, Fuzzy clustering.	**8**

TEXTBOOKS:

S. Sridhar, M. Vijayalakhshmi, Machine Learning, 1st Edition, Oxford university Press, 2021

REFERENCE BOOKS:

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer NP Exclusive, 1st Edition, 2009.
2. Tom. M. Mitchell, Machine Learning, 1st Edition, McGraw Hill Education, 2017.
3. M. Gopal, Applied Machine Learning, 2nd Edition, McGraw Hill, 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

- **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	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**0**	**2**	**2**	**1**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**0**	**2**	**0**	**0**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**1**	**3**	**3**	**3**
CO4	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**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, CD3, CD6
CO2	CD1, CD2, CD3, CD5, CD6
CO3	CD1, CD2, CD3, CD4, CD6, CD7
CO4	CD1, CD2, CD3, CD6, Cd7
CO5	CD2, CD3, CD5, CD6


RANCHI

COURSE INFORMATION SHEET

Course Code: CS24315
Course Title: Introduction to Cyber Security
Pre-requisite(s): 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:

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: CS24314
Course Title: Machine Learning Lab
Pre-requisite(s): CS2401 Data Structures and Algorithms
Co- requisite(s): CD24313 Machine Learning
Credits: L: 0 T: 0 P: 3
Class schedule per week: 3
Class: B.Tech.
Semester / Level: VI/3
Branch: Computer Science and Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To develop hands-on skills in implementing machine learning algorithms using ML libraries (e.g., scikit-learn, TensorFlow).
	To enable students to preprocess and analyze real-world datasets for model training and evaluation.
	To strengthen the understanding of supervised, unsupervised, and reinforcement learning through practical experiments.
	To foster the ability to select appropriate ML models and tune hyperparameters for optimal performance.
	To encourage problem-solving through ML applications in domains like classification, regression, clustering, and recommendation systems.

COURSE OUTCOMES (COs)

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

CO1	Implement core machine learning algorithms using programming tools and libraries.
CO2	Preprocess and analyze datasets to prepare them for training ML models.
CO3	Build and evaluate supervised and unsupervised learning models on real-world problems.
CO4	Tune model parameters and improve accuracy using validation techniques.
CO5	Develop ML-based solutions for classification, regression, and clustering tasks.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction and Environment Setup Introduction to application-based Machine Learning Concepts, setting up ML environment (e.g. Anaconda / Jupyter etc.), Libraries related to ML applications (e.g. NumPy, pandas, matplotlib etc.), Data loading, Exploratory Data Analysis, Basic statistical analysis, Dimensionality reduction using PCA, SVD etc.	**2**
Module – II Data Visualization and Regression Data set balancing, implementation of data visualization using histograms, scatter plots, heatmaps on data sets of various modalities, Linear and Polynomial Regression, practical concepts of overfitting and underfitting, Evaluation metrics	**2**

(MSE, RMSE, R^2 Score)	
Module – III Supervise Learning Designing classifiers on datasets (Iris, Breast Cancer, etc.), Developing models to solve classification problems, Implementation of classification algorithms like k-Nearest Neighbor, Decision Tree, Logistic Regression, Naïve Bayes, model training, testing and validation, comparing performance of the models using confusion matrix, ROC, AUC etc.	**4**
Module – IV Unsupervised Learning Designing clustering algorithms, implementing clustering techniques like K-Means, K-Medoid, Hierarchical clustering (AGNES, DIANA etc.), DBSCAN, Visualizing clusters, Evaluation of clustering performance.	**3**
Module – V Advanced topics and Real-Life Mini Projects Introduction to Neural Networks using tools (TensorFlow/ Keras etc.), Hyperparameter tuning, Designing and implementing Real-world ML project (classification/regression/clustering-based) with performance evaluation.	**2**

TEXTBOOKS:

Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, Shroff/O'Reilly, 2021

REFERENCE BOOKS:

1. Sebastian Raschka & Vahid Mirjalil, Python Machine Learning, 2nd Edition, Packt Publishing, 2017.
2. Joel Grus, Data Science from Scratch, 1st Edition, Shroff/O'Reilly, 2015.

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	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	CD2, CD3, CD4, CD5, 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: CS24318
Course Title: Embedded Systems Lab
Pre-requisite(s):
Co- requisite(s):
Credits: L: T: 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**
	3

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,	
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

15. 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: CS24351
Course Title: Natural Language Processing
Pre-requisite(s): Mathematics for AI-ML (AI24201)
Co- requisite(s): Supervised and Unsupervised Learning (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:

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

REFERENCE BOOKS:

4. 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: 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:

	To understand and apply knowledge of software process models and software project management practices
	To appropriately capture and document software requirement effectively utilize software requirement engineering practices.
	To provide robust technical design solution for software requirement.
	To deploy mechanism for quality software production.
	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	**8**

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	
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

- **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
CO	2	1	2	1	1	1	1	1	1	1	1	1	1	2	1

4															
CO 5	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: CS24355
Course Title: INFORMATION AND CODING THEORY
Pre-requisite(s): Elementary discrete mathematics, Data structure and Algorithms
Co- requisite(s): Nil
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class: B.TECH
Semester / Level: VII
Branch: Computer Sc. and Engg
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand the role of information theory in digital communication system..
	Understand encoding and decoding of digital data streams.
	Have a complete understanding of error-control coding.
	Introduce methods for the generation of these codes and their decoding techniques.
	Evaluate the performance of various coding techniques over noisy communication channels

COURSE OUTCOMES (COs)

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

CO1	Understand the principles behind efficient, correct and secure transmission of digital data stream.
CO2	Attain knowledge about the encoding and decoding of digital data streams.
CO3	Adapt with the basics of error-coding techniques.
CO4	Analyse the performance of various coding techniques.
CO5	Apply the gained knowledge to conduct research in information theory.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: *Source Coding*: Introduction to Information Theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measure for Continuous Random Variables, Source coding theorem, Huffman Coding, Shannon- Fano Coding, Arithmetic Coding, Lempel-Ziv Algorithm, Run Length Encoding, Rate Distribution Function.	**10**
Module – II: Channel Capacity and Coding: Introduction, Channel Model, Channel Capacity, Channel Coding, Information Capacity Theorem, Shannon Limit, Channel Capacity for MIMO System, Error Control Coding (Channel Coding).	**06**
Module – III: Linear Block Codes for Error Correction: Introduction to Error Correction Codes, Basic Definitions, Matrix Description of Linear Block Codes, Equivalent Codes, Parity Check Matrix, Decoding of Linear Block Code, Syndrome Decoding, Error Probability after Coding (Probability of Error Correction), Perfect Codes, Hamming Codes, Low Density Parity Check (LDPC) Codes.	**10**

Module – IV: Cyclic Codes: Introduction to the Cyclic Codes, Polynomials, The Division Algorithm for Polynomials, A Method for Generating Cyclic Codes, Matrix Description of Cyclic Codes, Burst Error Correction, Cyclic Redundancy Check (CRC) Codes, Circuit Implementation of Cyclic Codes, Introduction to BCH codes, Decoding of BCH codes	**08**
Module – V: Convolutional Codes: Introduction, Polynomial description of Convolutional Codes, Generator function, Tree and Trellis Codes, Matrix description of Convolutional Codes, Viterbi Decoding of Convolutional codes.	**06**

TEXTBOOKS:

1. Bose R., "Information theory Coding and Cryptography", 2nd Edition, McGraw-Hill, 20082. Raman Tulasi and Swamy M.N.S., Graph, Networks and Algorithms, John Wiley, 1981.(T2)

REFERENCE BOOKS:

1. Arijit Saha, Nilotpal Manna, Surajit Mandal, Information Theory, Coding and cryptography, Pearson India, 2013.
2. Cover Thomas and Joy Thomas, Elements of Information Theory, Wiley India Pvt. Ltd. 2nd Edition, 2006.

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	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
CO2	1	1	1	1	1	0	1	2	2	1	1	2	3	3	2
CO3	3	2	0	1	1	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: 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	**12**

Pre-processing: tokenization, stop word, normalization, stemming, wildcard queries, spelling correction – edit distance and k-gram; Indexing: Index construction; Index compression.	
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

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

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 ● **Implement different web crawling algorithms and compare their performance and behavior.** ● **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	**4**

offline data) 6. **Apply text preprocessing techniques: tokenization, stop word removal, stemming, and lemmatization.** 7. **Create an incidence matrix, analyze its size, and perform Boolean queries for document retrieval.** 8. **Build an inverted index using various data structures (dictionary, B-Tree, hash map) and analyze their efficiency.** 9. **Implement merge algorithms and their extensions (e.g., skipping pointers, DAAT, TAAT) for efficient query processing.** 10. **Create index using BSBI (Blocked Sort-Based Indexing) and SPIMI (Single-Pass In-Memory Indexing) techniques.** 11. **Implement phrase queries using positional indexes to support ordered and adjacent term matching.** 12. **Implement Levenshtein distance and bigram indexing techniques to handle spelling errors and support approximate string matching.**	
Module – III: Scoring 5. **Implement different ranking functions (Cosine Similarity, RSV, BM25) using the TF-IDF weighting scheme and compare their accuracy.** 6. **Implement a PageRank algorithm to evaluate the importance of web pages based on link structure.**	**2**
Module – IV: IR evaluation and Query Expansion 5. **Implement different evaluation techniques for both unranked and ranked retrieval systems to assess performance.** 6. **Implement the Rocchio algorithm for query reformulation and analyze its impact on retrieval effectiveness.**	**1**
Module – V: Language Model for Information Retrieval 5. **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

- **Student Feedback on Course Outcome**
- **Student Feedback on Faculty/Content Delivery**
- **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: CS24363
Course Title: Soft Computing
Pre-requisite(s): Discrete Mathematics
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand and learn the concept of fuzzy logic and controllers
	Learn the various architectures of ANN and its learning methods
	Learn about basic concepts of genetic algorithm and its operators
	Apply Fuzzy logic, ANN and Genetic algorithms

COURSE OUTCOMES (COs)

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

CO1	Solve numerical on Fuzzy sets and Fuzzy Reasoning
CO2	Develop Fuzzy Inference System (FIS).
CO3	Solve problems on Genetic Algorithms
CO4	Explain concepts of neural networks
CO5	Develop neural networks models for various applications.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Fuzzy Set Theory**: Basic Definition and Terminology, Set Theoretic Operations, Fuzzy types and levels, MF Formulation and Parameterization, MF of two dimensions, Fuzzy Union, Intersection and Complement, Fuzzy Number,Fuzzy measure.	**8 Hr.**
Module – II Fuzzy Logic: Fuzzy Rules and Fuzzy Reasoning:Extension Principles and Fuzzy Relations, Fuzzy IF THEN Rules, Defuzzification,FuzzyReasoning.Fuzzy Inference System: Introduction, Mamdani Fuzzy Models, Other Variants, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models.	**8 Hr.**
Module – III **Fundamentals of Genetic Algorithms:** Basic Concepts, Creation of Offsprings, Encoding, Fitness Functions, Reproduction, Genetic Modelling: Inheritance Operators, Cross over, Inversion and detection, Mutation operator, Bitwise operators.	**8 Hr.**
Module – IV **Introduction to Artificial Neural Networks:** What is a Neural Network? Human Brain, Models of Neuron, Neural Network viewed as Directed Graphs, Feedback, Network Architecture, Knowledge Representation, Learning processes:(Error correction,MemoryBased,HebbianCompetitive,Boltzma,Supervised,Unsupervised) Memory,Adaptation	**8 Hr.**
Module – V Perceptrons, Adaline, Back Propagation Algorithm, Methods of Speeding,	**8 Hr.**

Convolution Networks, Radical Basis Function Networks, Covers Theorem, Interpolation Learning, The Hopfield Network	

TEXTBOOKS:

1. Jang J.S.R., Sun C.T. and Mizutani E., "Neuro-Fuzzy and Soft Computing" PHI/Pearson Education, New Delhi 2004.(T1)
2. Rajasekaran S. & Vijayalakshmi G.A. Pai, PHI, New Delhi 2003.(T2)
3. Ross T. J., "Fuzzy Logic with Engineering Applications." TMH, New York, 1997.(T3)
4. HaykinsSimon ,"Neural Networks :A Comprehensive Foundation, Pearson Education,2002.(T4)

REFERENCE BOOKS:

1. Ray K.S. ,"Soft Computing and Its application", Vol 1, Apple Academic Press, 2015. (R1)
2. Lee K.H. ,"First Course on Fuzzy Theory and App.", Adv in Soft Computing Spinger, 2005.(R2)
3. Zimmermann H.Z. ,"Fuzzy Set Theory and its App " , 4th Edition, Spinger Science, 2001.(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
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	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	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


RANCHI

COURSE INFORMATION SHEET

Course Code: CS24364
Course Title: Soft Computing Lab
Pre-requisite(s):
Co- requisite(s): Soft 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:

●	Implement the concept of fuzzy logic and controllers
●	Implement various architectures of ANN and its learning methods
●	Implement concepts of genetic algorithm and its operators
●	Apply Fuzzy logic, ANN and Genetic algorithms

COURSE OUTCOMES (COs)

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

CO1	Solve numerical on Fuzzy sets and Fuzzy Reasoning
CO2	Develop Fuzzy Inference System (FIS).
CO3	Solve problems on Genetic Algorithms
CO4	Explain concepts of neural networks
CO5	Develop neural networks models for various applications.

SYLLABUS

MODULE	(NO. OF Labs)
Module – I **Programs based on Fuzzy Set Theory and various membership functions**	**3**
Module – II **Programs based on Fuzzy Logic, fuzzy rules and Fuzzy inference based systems**	**3**
Module – III **Programs based on Genetic Algorithms**	**2**
Module – IV **Programs based on Artificial Neural Networks**	**3**
Module – V	**2**

Programs based on Back Propagation Algorithm, Methods of Speeding, Convolution Networks	

TEXTBOOKS:

Soft Computing: With MATLAB Programming by N.P. Padhy and S.P. Simon Oxford University Press, Inc. 198 Madison Ave. New York, NY United States., 2015

REFERENCE BOOKS:

Principles of Soft Computing Using Python Programming: Learn How to Deploy Soft Computing Models in Real World Applications by Gypsy Nandi **Wiley-IEEE Press, 2023.**

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/ 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	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: **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)

13. PSO1 (ML/AI/Data): Strongly tied to almost every CO, especially CO2–CO5.
14. PSO2 (Research/Projects): Restoration, segmentation, and compression modules are essential for research work.
15. 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

- Image Sampling and Quantization
  - Simulate image sampling at different resolutions and quantization levels.
  - Analyze perceptual loss vs file size.
- Intensity Transformations
  - Implement contrast stretching, logarithmic, and power-law transformations.
  - Apply to X-ray or satellite images to enhance features.
- Histogram Analysis and Equalization
  - Perform standard and adaptive histogram equalization (CLAHE).
  - Compare their effect on low-contrast images.
- 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

16. 2D DFT and Frequency Spectrum Visualization
    - Compute and display magnitude and phase spectrum.
    - Mask specific frequencies and reconstruct the image.
17. Design and Apply Frequency Domain Filters
    - Implement ideal, Gaussian, and Butterworth filters.
    - Compare their performance on noisy images.
18. Image Sharpening via High-Frequency Emphasis Filtering
    - Enhance details by combining high-pass filtered image with original.
19. Transform Coding for Compression
    - Apply DCT and Walsh Transform to compress images.
    - Evaluate reconstructed image quality via PSNR.

Module III: Image Restoration

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

Module IV: Image Compression

7. Implement Huffman and Run-Length Encoding
   - Apply lossless compression techniques to grayscale images.
   - Plot code efficiency and compression ratio.
8. 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

6. Morphological Operations on Binary Images
   - Erosion, dilation, opening, closing, boundary extraction.
   - Apply on text images or scanned maps.
7. 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: CS24367
Course Title: Computer Graphics
Pre-requisite(s): Design and Analysis of Algorithm
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 3
Class: BTECH
Semester / Level: 3
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Understand Fundamental Concepts of Computer Graphics
	Develop the practical skills for CG
	Explore Applications based on CG
	Learn Mathematical Foundations behind Computer Graphics

COURSE OUTCOMES (COs)

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

CO1	Acquire the knowledge of fundamental algorithms, data structures, and mathematical concepts used in computer graphics.
CO2	Design, modify, and create graphical content using tools and techniques.
CO3	Evaluate and compare different algorithms for CG enabled tasks.
CO4	Create content using 2D and 3D graphics.
CO5	Apply knowledge and skills to succeed in industries applications.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Mathematics for Computer Graphics : Coordinate Frames, Cartesian, polar, 3D, 3D Curvilinear Coordinate Systems, Solid Angle, Points and Vectors, Orthonormal Basis, Metric Tensor, Non-Parametric and Parametric Representations, Fitting Curves to Data Sets	**10**
Module – II Output primitives: Points, Lines, Line drawing algorithm, Circle Generating Algorithms, Conic Sections, Pixel Addressing, Filled Area primitives	**8**
Module – III 2D Geometric Transformations and Viewing: Basic and composite 2D Transformations, Viewing Pipeline, Line, Polygon and Curve Clipping	**8**

Module – IV 3D Geometric Transformations, Modelling and Viewing : Basic and Composite 3D Transformations, 2D and 3D Projections,	**6**
Module – V Three Dimensional Concepts and Object Representation: Three-Dimensional Display Methods, Polygon Surfaces, Curved Lines & Surfaces, Quadric Surfaces, Spline Representations. Visible Surface Detection Methods and Algorithms	**8**

Text books:

Hearn D. & Baker M.P. , Computer Graphics, 2/e , Pearson Education, New Delhi, 2005.(T1)

Reference books:

Foley J.D. et. Al, A Fundamental of Computer Graphics, Addition Wesley, London, 1993.(R1)

Krishnamurthy N, Introduction to Computer Graphics, 1stEdn., TMH, 2002.(R2)

Rogers B., Mathematical elements of Computer Graphics, McGraw Hill, 1989.(R3)

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

POS MET THROUGH GAPS IN THE SYLLABUS: YES

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN : Illumination Models, Surface Rendering, Computer Animations

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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	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: CS24368
Course Title: Computer Graphics LAB
Pre-requisite(s):
Co- requisite(s):
Credits: L: T: P:
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Learn Computer Graphics Programming Skills
	Learn Algorithm Implementation for 2D and 3D
	Visualize 2D and 3D Model Objects
	Learn Graphical Applications

COURSE OUTCOMES (COs)

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

CO1	Create Pictures using 2D and 3D Graphics
CO2	Develop techniques for rendering, clipping and transformations
CO3	Implement Algorithms for 2D and 3D Model
CO4	Create dynamic scenes to represent Animation
CO5	Develop Computer Graphics based solutions for different Applications

SYLLABUS

MODULE	(NO. OF LABS)
Module – I Programs based different geometrical figures. Programs based on Computer Graphics Foundations	**2**
Module – II Programs based on Transformations, Clipping and Viewing Algorithms	**3**
Module – III Programs based on Projection and 3D Graphics	**3**
Module – IV Programs based on Curves, Surfaces	**2**
Module – V Programs based on 2D and 3D Geometry, Programs based on Graphical Applications	**3**

TEXTBOOKS:

Graphics Using C, by Yashwant Kantekar, BPB Publication

REFERENCE BOOKS:

Open Gl Programming Language: The Official Guide to Learning Open Gl, Version 1.2, 3/E , Pearson Education Publisher

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

POS MET THROUGH GAPS IN THE SYLLABUS : YES

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: Multimedia Tools,

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**
- **Student Feedback on Faculty/Content Delivery**
- **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

	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: CS24371
Course title: Wireless Sensor Networks
Pre-requisite(s):
Co-requisite(s):
Credits: L:3 T:0 P:0
Class schedule per week: 3
Class: B. Tech
Semester / Level:
Branch:

Course Objectives
This course enables the students:

1.	Familiarize with the principles of sensor nodes, network deployment and architectures.
2.	Know the data transmission and routing protocols. Know the differences among different networks.
3.	Analyze or compare the performance of different routing and MAC protocol
4.	Evaluate the performance of different MAC protocols and clustering algorithm
5.	Compute the throughput and channel utilization for different network scenarios.

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

1.	Obtain a broad understanding about the network architecture of wireless sensor network.
2.	Understand all basic characteristics of wireless sensor networks and sensor nodes.
3.	Understand the principles of data transmission, clustering algorithm and routing protocols.
4.	Analyse and evaluate different constraint of wireless sensor network, e.g., coverage, power management, security and data collisions.
5.	Design and development of new sensor network architecture.

Syllabus
Module I
Introduction: Wireless channel and communication fundamentals, Features of Wireless sensor network, Design principles for WSNs, Service interfaces of WSNs and Gateways, Applications, Hardware components, Sensor deployment mechanism. (6L)
Module II
Network and Component Technologies: Topologies and characteristics, Sensor network characteristics, energy consumption model, Power management, Localization, hierarchical and cluster-based topology control. (10L)
Module III
Data Transmission and Routing: Data processing and aggregation, Data storage, Network clustering protocols, Multi-hop communication protocols, Energy efficient routing, Data aggregation and data centric routing. (8L)

Module IV

Protocols: MAC Protocols, Framing and error control in WSNs, Medium access control protocols, Congestion control and rate control protocols. (8L)

Module V

QOS Issues:

Coverage and deployment, Reliable data transport, Single packet and block delivery, Congestion control and rate control, Collisions, Collision avoidance mechanism. (8L)

Text books:

Karl Holger and Willig Andreas, "Protocols and Architectures for Wireless Sensor Networks".(T1)

Callaway Jr. Edgar H. and Callaway Edgar H., "Wireless Sensor Networks: Architectures and Protocols".(T2)

Reference books:

Zhang Yan, Jejunum, Hu Honglin, "Wireless Mesh Networking, Architecture, Protocols and Standards".(R1)

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

POs met through Gaps in the Syllabus:N/A

Topics beyond syllabus/Advanced topics/Design:N/A

POs met through Topics beyond syllabus/Advanced topics/Design:N/A

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	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 Faculty
2. Student Feedback on Course

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 Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
CO1	3	2	3	3	3	3	1	2	3	1	2	2	3	3	3
CO2	3	2	2	3	3	2	1	1	2	2	2	1	3	2	2
CO3	3	3	2	3	3	3	3	2	2	2	2	1	3	1	2
CO4	3	2	3	2	3	2	1	2	2	3	3	1	3	3	2
CO5	3	3	3	3	2	2	2	2	2	1	2	1	2	2	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: CS24373
Course Title: Formal Methods and Verification
Pre-requisite(s): CS24219 Formal Language and Automata Theory,

CS24203 Mathematics for Computer Science
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class:
Semester / Level: VI/3
Branch: CSE
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce the fundamental principles and role of formal methods in the development and verification of software and hardware systems.
2	Enable students to write formal specifications and apply reasoning techniques such as Hoare logic and theorem proving to verify program correctness.
3	Familiarize students with automated verification tools, including theorem provers, static analyzers, and model checkers.
4	Equip students to apply formal verification techniques in real-world systems using modern tools and testing strategies like symbolic execution and fuzzing.

COURSE OUTCOMES (COs)

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

CO1	Understand and explain the purpose and application areas of formal methods in system design and verification.
CO2	Write formal specifications and reason about software correctness using logical frameworks such as Hoare logic.
CO3	Apply theorem proving tools (e.g., Coq, Z3) to prove program properties and verify algorithmic correctness.
CO4	Use model checking and static analysis techniques to validate software behavior and uncover hidden bugs.
CO5	Perform automated and semi-automated verification and testing of real-world applications using symbolic execution, Java PathFinder (JPF), and AFL.

SYLLABUS

MODULE	(NO. OF LECTURE

	HOURS)
Module – I Introduction to Fomal Methods: Role of FM in software/hardware design industry, applications in industry, classification: model-based, algebraic, axiomatic, etc., FM in software development life cycle, Overview of Verification Techniques: model checking, theorem proving, static analysis, Benefits and limitations of Formal Methods	7
Module – II Formal Specification and Reasoning: Specification languages: Z, B-Method, writing specifications: syntax and semantics, software correctness: total vs partial correctness, Hoare logic, Proving program correctness using Hoare Triples.	7
Module – III Automated Reasoning and Theorem Proving: Logic and deduction systems, Automated theorem provers Coq, Isabelle, Z3, formal verification of sequential programs, proofs of program termination and invariants, tools for interactive and automatic proofs.	8
Module – IV Static Analysis and Symbolic Execution: Static analysis fundamentals: abstract interpretation, data flow analysis, verifying program contracts with static analysis, symbolic execution, integration with platforms like KLEE and Frama-C	8
Module – V Model Checking and Advanced Testing: Explicit-state model checking (SPIN), Symbolic model checking (NuSMV), Model-based test generation: using formal methods, static analysis for concurrent systems, white-box testing using Java PathFinder (JPF), Grey-box testing with AFL.	10

TEXTBOOKS:

1. M. Huth and M. Ryan, “Logic in Computer Science: Modeling, and Reasoning about Systems”, Cambridge University Press

2. Christel Baier and Joost-Pieter Katoen, “Principles of Model Checking”, The MIT Press.

3. A. Diller, Z: An Introduction to Formal Methods, Willey

REFERENCE BOOKS:

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	√	√	√	√	√
Semester End Examination	√	√	√	√	√

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	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminar
CD3	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: 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:

- 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:

- 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 Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Basics of WSN and MANET Networks	**8**

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	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

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 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

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	2	3	3	2	3	1	2	1	2	1	1	2	2	2	2
CO 2	2	3	3	3	2	2	1	1	1	1	1	2	2	3	2
CO 3	2	3	2	2	2	1	1	1	1	1	1	2	3	2	2
CO 4	2	2	2	3	2	2	1	1	1	1	1	3	2	2	2
CO 5	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: CS24457
Course Title: SYSTEM SIMULATION AND MODELLING
Pre-requisite(s): Mathematics, probability and Statistics
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
Class schedule per week: 3
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To Characterize engineering systems in terms of their essential elements, purpose, parameters, constraints, performance requirements, sub-systems, interconnections and environmental context.
	To understand Engineering problem modeling and solving through the relationship between theoretical and mathematical
	To provide Mathematical modeling real world situations related to engineering systems development,
	To able Generate random numbers and random variates using different Techniques.
	To provide the knowledge of queuing theory to solve real life problem

COURSE OUTCOMES (COs)

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

CO1	Define basic concepts in modeling and simulation (M&S).
CO2	Classify various simulation models and give practical examples for each category.
CO3	Understand the behavior of a dynamic system and create an analogous model for a dynamic system.
CO4	Generate and test random number variates and apply them to develop simulation models.
CO5	Develop a real life model using queuing system.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I The concepts of a system, System Environment, Stochastic Activities, continuous and discrete systems, System Modeling, Types of models. System Studies: Subsystem, A Corporate Model, Environment segment, Production Segment, Management Segment, full Corporate Model, Types of System study, System Analysis, System Design, System Postulation.	**8 Hr.**
Module – II The technique of simulation, the Monte Carlo method, comparison of simulation and	**8 Hr.**

analytical methods, experimental nature of simulation, types of system simulation, numerical computation technique for continuous & discrete models, distributed lag models, cobweb models. Continuous system models, differential equations, analog computers & methods, hybrid computers, CSSLs, CSMP-III, Feedback Systems, Simulation of an Autopilot	
Module – III Exponential Growth & decay models, modified exponential growth models, logistic curves, generalization of growth models, system dynamics diagrams, Simple system dynamics diagrams, multi–segment models, representation of time delays.	**8 Hr.**
Module – IV Evaluation of continuous probability functions, continuous uniformly distributed random numbers; a uniform random number numbers, generating discrete distributions, non-uniform continuously distributed random numbers, the rejection method. **Random numbers Generators:** Techniques for generating random numbers. Test for random numbers. **Random vitiate Generation:** Inverse transform technique, exponential distribution, uniform distribution.	**8 Hr.**
Module – V Queuing disciplines, measures of queues. Discrete events, representation of time, generation of arrival patterns, simulation of a telephone system, delayed calls, Simulation programming tasks, measuring utilization and occupancy.	**8 Hr.**

TEXTBOOKS:

14. Gordon Geoffrey, "System Simulation", 2nd Edition, Pearson Education, 2007.
15. Banks J., Carson J. S., Nelson B.L., Nicol D.M. Nicol, "Discrete-Event System Simulation", 4th Edition, Pearson Education, 2007.

REFERENCE BOOKS:

John A. Sokolowski, Catherine M. Banks," Principles of Modeling and Simulation: A Multidisciplinary Approach, 2009 John Wiley & Sons, Inc.

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)		
CS24xx	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	1	1	3	3	2	1	2	3	2
CO2	3	1	3	3	3	2	2	3	3	1	3	3	3	3	3
CO3	2	2	1	1	2	3	3	2	2	2	1	1	3	3	2
CO4	3	3	1	3	3	1	2	1	3	3	1	3	3	3	2
CO5	3	1	3	3	3	1	2	1	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	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: CS24458
Course Title: SYSTEM SIMULATION AND MODELLING LAB
Pre-requisite(s):
Co- requisite(s): System Simulation
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:

●	Introduction to different types of systems
●	Introduction to Continuous and discrete systems
●	Simulation of Random numbers and generation methods
●	Simulation of queuing system related to real life.

COURSE OUTCOMES (COs)

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

CO1	Simulate the different systems
CO2	Simulation of real time applications based on continuous and discrete systems.
CO3	Simulate Random number generation and random variates.
CO4	Develop or simulate a Goodness of fitness test
CO5	Develop a real life model using queuing system.

SYLLABUS

MODULE	(NO. OF Labs)
Module – I **Programs based on continuous and discrete systems.**	**3**
Module – II **Programs based on Random numbers generations and random variates**	**3**
Module – III **Simulation of real life applications using random numbers and random variates.**	**2**
Module – IV **Programs based on various Goodness of fit tests**	**3**

Module – V **Simulation of single server and multi server**	**2**

TEXTBOOKS:

Modeling and Simulation in Python: An Introduction for Scientists and Engineers by Allen B. Downey Publisher:No Starch Pr, 2023.

System Simulation with Digital Computer Paperback by Deo, Publisher : Prentice Hall India Learning Private Limited, 1978.

REFERENCE BOOKS:

Banks J., Carson J. S., Nelson B.L., Nicol D.M. Nicol, "Discrete-Event System Simulation", 4th Edition, Pearson Education, 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	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

16. **Student Feedback on Course Outcome**
17. **Student Feedback on Faculty/Content Delivery**
18. **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	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: 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

- **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
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:

- **Excel Solver: A built-in optimization tool in Microsoft Excel.**
-
- **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

- **Student Feedback on Course Outcome**

- **Student Feedback on Faculty/Content Delivery**
- **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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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: CS24461
Course Title: Blockchain Technology
Pre-requisite(s):
Co- requisite(s):

Credits: L: T: P:
Class schedule per week:
Class:
Semester / Level:
Branch:
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	To provide an overview of the different blockchain technologies.
	To provide the knowledge of cryptocurrency design and its security against scam ,fraud, hacking.
	To provide the ability to design and implement new ways of using blockchain for applications other than cryptocurrency.
	To be able to apply the knowledge gained through the course in actual blockchain development or blockchain contract developer

COURSE OUTCOMES (COs)

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

CO1	Learn and explain the difference between centralized, decentralized network and blockchain.
CO2	Explain fundamental concepts of blockchain using hashes and consensus.
CO3	Understand the concept of mining in blockchains.
CO4	Understand the working of Bitcoin and its security.
CO5	Know about the different platforms for implementing blockchain and its varied application.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Blockchain Technology:** Introduction to Blockchain, History of Blockchain, Trusted Third party for transactions, Difference between centralized, decentralized and distributed peer to peer networks, Types of Blockchain (Permission Blockchain vs. Permissionless Blockchain), History of Bitcoins, Components and limitations of Blockchain. **Cryptographic Primitives:** Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, Zero-knowledge systems, Encryption vs. Hashing	**8**
Module – II **Fundamental concepts of Blockchain:** Concepts of Block, Transactions: Recording transactions, Digital Signature, Verifying and confirming transactions, Blocks and blockchain: Hash pointers, Blocks, Consensus building. Distributed consensus, Byzantine general problems, Consensus mechanism: POW, POS, POB, POA, etc. Blockchain Architecture, Markle Root Tree	**8**
	8

Module – III **Mining and simulating blockchain:** Mining and simulating blockchain: Game theory behind competitive mining. Incentives: mining and transaction fees, Energy expended in mining. **Smart Contracts:** Definition, Lifecycle, History, Features, Types and Working, Contract deployment, access control, Smart contract vulnerability, Advantages and Challenges.	
Module – IV **Cryptocurrency:** Bitcoin creation, exchanges. Wallets, security. Protecting blockchain from attackers. Forks – soft and hard, Blockchain security, Key Management in Bitcoin, LiteCoin, AltCoins, **Security:** Common attacks on Blockchain: 51% Attack, Sybil Attack, Replay attack, Double spending attack.	**8**
Module – V **Platforms and Applications:** Introduction to Blockchain platform: Ethereum, Hyperledger Fabric, EVM, IOTA, EOS, Multichain, Bigchain, CORDA, SOLIDITY, designing a new blockchain, Distributed Application (DAPP) Plug and Play Blockchain mechanism **Applications:** Case studies: E-Governance, Elections, File sharing, Supply-Chain management Challenges and Research Issues in blockchain	**8**

TEXTBOOKS:

- Bitcoin and Cryptocurrency technologies: a comprehensive introduction. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Princeton University Press, First edition,2016
- Blockchain Applications: A Hands-On Approach. Arshdeep Bahga, Vijay Madisetti. VPT Publisher. First edition, 2018.
- Blockchain: Step – by – Step Guide to Understand by Paul Laurence, Createspace Independent Pub.

REFERENCE BOOKS:

19. Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners by Chris Dannen, Apress
20. Blockchain: The comprehensive beginner's guide by Frank Walrtin

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**	**2**	**2**	**3**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**0**	**1**	**1**	**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	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: CS24462
Course Title: Blockchain Technology 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:

	To provide an Handson on RemixIDE using Solidity programming to create smart contracts
	To provide the Handson knowledge on creation of crypto wallet like MetaMask and making some transaction using Ganache
	To provide the Handson on deployment of smart contracts on Ganache using Truffle
	To provide the Handson on full stack using web3 and blockchain development framework specially truffle

COURSE OUTCOMES (COs)

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

CO1	Create smart contracts using Solidity programming using RemixIDE
CO2	Create a crypto wallet like MetaMask and make transactions between accounts that imported from Ganache.
CO3	Deploy smart contracts on Ganache
CO4	Develop full stack using blockchain
CO5	Develop small real time applications using blockchain technology

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Solidity Programming**	
Module – II **CrytoWallet using MetaMask, transaction creation**	

Module – III **Smart Contract Deployment**	
Module – IV **Full Stack Blockchain**	
Module – V **Designing Blockchain Application**	

TEXTBOOKS:

- Bitcoin and Cryptocurrency technologies: a comprehensive introduction. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Princeton University Press, First edition,2016
- Blockchain Applications: A Hands-On Approach. Arshdeep Bahga, Vijay Madisetti. VPT Publisher. First edition,2018.
- Blockchain: Step – by – Step Guide to Understand by Paul Laurence, Createspace Independent Pub.

REFERENCE BOOKS:

- Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners by Chris Dannen, Apress
- Blockchain: The comprehensive beginner's guide by Frank Walrtin

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**	**2**	**2**	**3**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**1**	**1**	**1**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**0**	**1**	**1**	**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	
CO2	
CO3	
CO4	
CO5	

COURSE INFORMATION SHEET

Course Code: CS24473
Course Title: GRAPH THEORY
Pre-requisite(s): Elementary discrete mathematics, Data structure and Algorithms
Co- requisite(s): Nil
Credits: L: 3 T: 0 P: 0
Class schedule per week:
Class: B.TECH
Semester / Level: VII
Branch: Computer Sc. and Engg
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

	Learn and become comfortable with graphs and its terminologies.
	Understand applications of graph theory to practical problems and other branches of mathematics
	Understand various graphs algorithms along with its analysis.
	Practice creative problem solving and improve skills in this area

COURSE OUTCOMES (COs)

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

CO1	Analyze different types of graphs and their applications in real world.
CO2	Perceive the role of cut-set, cut-vertex and fundamental circuits in network flows.
CO3	Create an awareness of planar and dual graph.
CO4	Explain how to represent graphs in a computer system
CO5	Apply the concept of graph colouring and partitioning techniques in NP-problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Introduction: Graphs and its applications, Finite and infinite graphs, incidence and degree, isolated Vertex, pendant Vertex, and Null graph, paths and circuits, isomorphism, sub graphs, walks, paths, and circuits, connected graphs, disconnected graphs and components, connectivity checking algorithm, Euler graphs, Operations on graphs, more on Euler graphs, Hamiltonian paths and circuits, Travelling Salesman problem.	**10**
Module – II: Trees and Fundamental circuits: Trees and its properties, Distance and centres in a tree, Algorithm for checking if a graph is Tree, Spanning trees, Spanning trees in a Weighted graph, Prim's and Kruskal's algorithms. Cut set and cut vertices: Properties of a cut set, Fundamental circuits and cut sets, connectivity and separability, Computing connected components, Network flows, 1-Isomorphism, 2-Isomorphism.	**08**

Module – III: Planar and Dual Graphs: Planar graph, Kuratowski's Graphs, Representations of a planar graph, Detection of planarity, Planar Separator Theorem, Geometric Dual, Combinatorial, Duel, Thickness and crossings, Algorithms for finding Clique and maximum clique.	**08**
Module – IV: Matrix Representation of Graphs: Incidence matrix, Adjacency matrix, Adjacency list, Circuits Matrix, Fundamental Circuit Matrix , Cut-set Matrix, Relationships among Af, Bf and Cf.	**06**
Module – V: Colouring, Covering and partitioning: Chromatic number, Chromatic partitioning, Chromatics polynomial, Coverings, Four colour problem, Algorithm for graph colouring. Directed Graphs: Digraphs and its types, Digraphs and binary Relations, Directed paths and connectedness, Euler Digraphs, Trees with Directed Edges, Fundamental Circuits in Digraphs, Adjacency Matrix of a Digraph, Paired Comparisons and Tournaments	**08**

TEXTBOOKS:

1. Deo Narasingh, Graph Theory with Applications to engineering and Computer Science, Prentice Hall of India, 2001.(T1)

2. Raman Tulasi and Swamy M.N.S., Graph, Networks and Algorithms, John Wiley, 1981.(T2)

REFERENCE BOOKS:

1. West Douglas B., Introduction to Graph theory, Pearson Education, 2002.(R1)

2. Harary F., Graph Theory, Addison Wesley/ Narosa, 1998. (R2)

3. Reingold E. M., Nievergelt J., Deo N., Combinatorial Algorithms: Theory and Practice, R.(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
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	3	3	2	0	0	0	0	0	0	0	0	0	0	0	0
CO2	1	1	1	1	1	0	1	2	2	1	1	2	3	3	2
CO3	3	2	0	1	1	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: CS24475
Course Title: Cryptography and Network Security
Pre-requisite(s): Data Communication and Computer Network
Co- requisite(s):
Credits: L: 3 T: 0 P: 0
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 Attacks, The OSI Security Architecture, A Model for Network Security. Classical	**10**

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:

- Forouzan B. A., "Cryptography and Network Security", 3rd Edition, Mcgraw Higher Education, 2016.
- Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.
- Kahate A., "Crptography and Network Security", 3rd Edition, McGraw Hill Education, New Delhi, 2013.
- Schneier B., "Applied Cryptogaphy: Protocols, Algorithms And Source Code In C", 2nd Edition, Wiley, 2007.
- W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
- 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

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 Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	2	2	2	1	2	2	2	3	2	3	3
CO2	3	3	3	3	3	1	1	1	1	1	2	2	3	3	2

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

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