

R25

**Curriculum & Syllabus
Under Autonomy**

Computer Science and Engineering
(Artificial Intelligence and Machine Learning)
(Effective from 2025-26 admission batch)

Department: CSE

Curriculum Structure & Syllabus
(Effective from 2025-26 admission batch)

Department: CSE (AI&ML) Curriculum Structure & Syllabus
(Effective from 2025-26 admission batch)

		1 st Year 1 st Semester							
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Multidisciplinary	YCS1001	Basic Electrical Engineering	3	0	0	3	3
2	SCI	Minor	YMT1001	EngineeringMathematics–I	3	0	0	3	3
3	SCI	Minor	YPH1001	Engineering Physics	3	0	0	3	3
4	ENGG	Major	YCS 1002	Programming for ProblemSolving	3	1	0	4	4
5	HUM	Ability Enhancement Course	YED1003	Indian Knowledge System	2	0	0	2	1
B.PRACTICAL									
6	ENGG	Multidisciplinary	YCS 1101	Basic Electrical Engineering Laboratory	0	0	3	3	1.5
7	ENGG	Skill Enhancement	YCS1103	Workshop & Manufacturing Practices Laboratory	0	0	3	3	1.5
8	ENGG	Major	YCS1102	Programming for Problem Solving Laboratory	0	0	3	3	1.5
9	HUM	Minor	YPH1101	Engineering Physics Laboratory	0	0	3	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
10	MC	MandatoryCourse	YCS1502	Seminar/Group Discussion	0	0	0	0	1
11	MC	MandatoryCourse	YCS1503	SkillX	0	0	0	0	1
TotalofTheory,PracticalandMandatoryActivities /Courses								27	20

***HUM: Humanities; ENGG: Engineering; SCI: Science; PRJ: Project; MC: Mandatory Activities/Courses**

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1 st Year2 nd Semester									
Sl. No.	Broad Category	Category	Course Code	CourseTitle	Hours perweek				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Minor	YCS2001	Basic Electronics Engineering	3	0	0	3	3
2	ENGG	Major	YCS2002	Data Structures	3	1	0	4	4
3	SCI	Multidisciplinary	YCH2001	Engineering Chemistry	3	0	0	3	3
4	ENGG	Minor	YCS2003	EngineeringMathematics –II	3	1	0	4	4
5	HUM	Common value added course	YED2001	Professional Communication	1	1	0	2	1
B.PRACTICAL									
6	ENGG	Major	YCS2102	Data Structures Laboratory	0	0	3	3	1.5
7	ENGG	Minor	YCS2101	Basic Electronics Laboratory	0	0	3	3	1.5
8	HUM	Minor	YED2101	Professional Communication Laboratory	0	0	2	2	1
9	ENGG	Minor	YCS2301	Engineering Graphics & Design Laboratory	0	0	3	3	1.5
10	SCI	Multidisciplinary	YCH2101	Engineering Chemistry Laboratory	0	0	3	3	1.5
11	HUM	Ability Enhancement	YCS2505/ JSC2503	Life Skills / Communicative English Proficiency	0	0	1	1	1
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
11	HUM	Ability Enhancement Course	YCS2502	Seminar / Group Discussion	0	0	1	1	1
12	MC	Mandatory Course	YCS2501	NSS/Physical Activities /Meditation &Yoga/ Photography	0	0	1	1	1
13	MC	Mandatory Course	YCS2504	SkillX	0	0	1	1	1
Total of Theory, Practical and Mandatory Activities /Courses								33	23

2 nd Year3 rd Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Minor	YCS3005	Probability and Statistics	3	0	0	3	3
2	ENGG	Minor	YCS3001	Digital Logic and Electronics	3	0	0	3	3
3	ENGG	Major	YCS3002	Computer Organization and Architecture	3	0	0	3	3
4	ENGG	Major	YCS3003	Design and Analysis of Algorithms	3	0	0	3	3
5	SCI	Minor	YCS3004	Computational Biology	3	0	0	3	3
B.PRACTICAL									
6	ENGG	Minor	YCS3101	Digital Logic and Electronics Laboratory	0	0	3	3	1.5
7	ENGG	Major	YCS3102	Computer Organization and Architecture Laboratory	0	0	3	3	1.5
8	ENGG	Major	YCS3103	Design and Analysis of Algorithms Laboratory	0	0	3	3	1.5
9	ENGG	Skill Enhancement Course	YCS3104	IT Workshop Laboratory(SciLab/MAT LAB/C++)	0	1	3	4	2.5
C.MANDATORY ACTIVITIES/COURSES(Non-CGPA)									
10	HUM	Ability Enhancement Course	YCS3501	Technical Seminar Presentation	0	0	1	1	1
11	MC	Mandatory Course	YCS3503	Ethical Hacking Concept	0	0	1	1	1
12	MC	Mandatory Course	YCS3502	SkillX	0	0	0	0	1
Total of Theory, Practical and Mandatory Activities / Courses								28	22

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2 nd Year 4 th Semester									
Sl. No.	Broad Category	Category	Course Code	CourseTitle	Hours perweek				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Minor	YCS4005	Discrete Mathematics	3	0	0	3	3
2	ENGG	Major	YCS4001	Operating Systems	3	0	0	3	3
3	ENGG	Major	YCS4002	Formal Language and Automata Theory	3	0	0	3	3
4	ENGG	Major	YCS4003	Object Oriented Programming using Java	3	0	0	3	3
5	HUM	Ability Enhancement Course	YBB4001	Principles of Management	2	0	0	2	2
B.PRACTICAL									
7	ENGG	Major	YCS4101	Operating Systems Laboratory	0	0	3	3	1.5
8	ENGG	Minor	YCS4102	Numerical Methods Laboratory	0	0	3	3	1.5
9	ENGG	Major	YCS4103	Object Oriented Programming using Java Laboratory	0	0	3	3	1.5
10	ENGG	Major	YCS4104	Programming Using Python Laboratory	0	0	3	3	1.5
C.MANDATORY ACTIVITIES/COURSES(Non-CGPA)									
11	HUM	Ability Enhancement Course	YCS4501	Soft Skill & Aptitude	1	0	0	1	1
12	MC	Mandatory Course	YED4501	Foreign Language	1	0	0	1	1
13	MC	Mandatory Course	YCS4502	SkillX	0	0	1	1	1
Total of Theory, Practical and Mandatory Activities /Courses								26	20

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3 rd Year 5 th Semester									
Sl. No.	Broad Category	Category	Course Code	CourseTitle	Hours perweek				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	YCS5001	Artificial Intelligence	3	0	0	3	3
2	ENGG	Major	YCS5002	Database Management Systems	3	0	0	3	3
3	ENGG	Major	YCS5003	Computer Networks	3	0	0	3	3
4	ENGG	Major	YCS5004A	Compiler Design	3	0	0	3	3
			YCS5004B	Cryptography and Network Security					
			YCS5004C	Computer Graphics					
5	HUM	Minor	YED5001	Economics for Engineers	2	0	0	2	2
B.PRACTICAL									
6	ENGG	Major	YCS5101	Artificial Intelligence Laboratory	0	0	3	3	1.5
7	ENGG	Major	YCS5102	Database Management Systems Laboratory	0	0	3	3	1.5
8	ENGG	Major	YCS5103	Computer Networks Laboratory	0	0	3	3	1.5
9	PRJ	Skill Enhancement	YCS5201	Internship	0	0	2	2	1.5
C.MANDATORYACTIVITIES/CO URSES(Non-CGPA)									
10	MC	Mandatory Course	YCS5501	Behavioral and Interpersonal skills	3	0	0	3	1
11	MC	Mandatory Course	YCS5502	SkillX	0	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses								28	20

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3 rd Year 6 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours perweek				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	YCS6001	Machine Learning	3	1	0	4	4
2	ENGG	Major	YCS6002	Digital Image Processing	3	0	0	3	3
3	ENGG	Major	YCS6003	Natural Language Processing	3	0	0	3	3
4	ENGG	Major	YCS6004A YCS6004B YCS6004C	Mobile Computing Quantum Computing Cloud Computing	3	0	0	3	3
5	ENGG	Minor	YLB6001	Cyber Law and Ethics	3	0	0	0	3
B.PRACTICAL									
6	ENGG	Major	YCS6101	Machine Learning Laboratory	0	0	3	3	1.5
7	ENGG	Major	YCS6102	Digital Image Processing Laboratory	0	0	3	3	1.5
8	ENGG	Major	YCS6103	Natural Language Processing Laboratory	0	0	3	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)									
9	MC	Mandatory Course	YCS6501	Innovation, Entrepreneurship &IPR	3	0	0	3	1
10	MC	Mandatory Course	YCS6502	SkillX	0	0	0	0	1
TotalofTheory,PracticalandMandatoryActivities /Courses								24	20.5

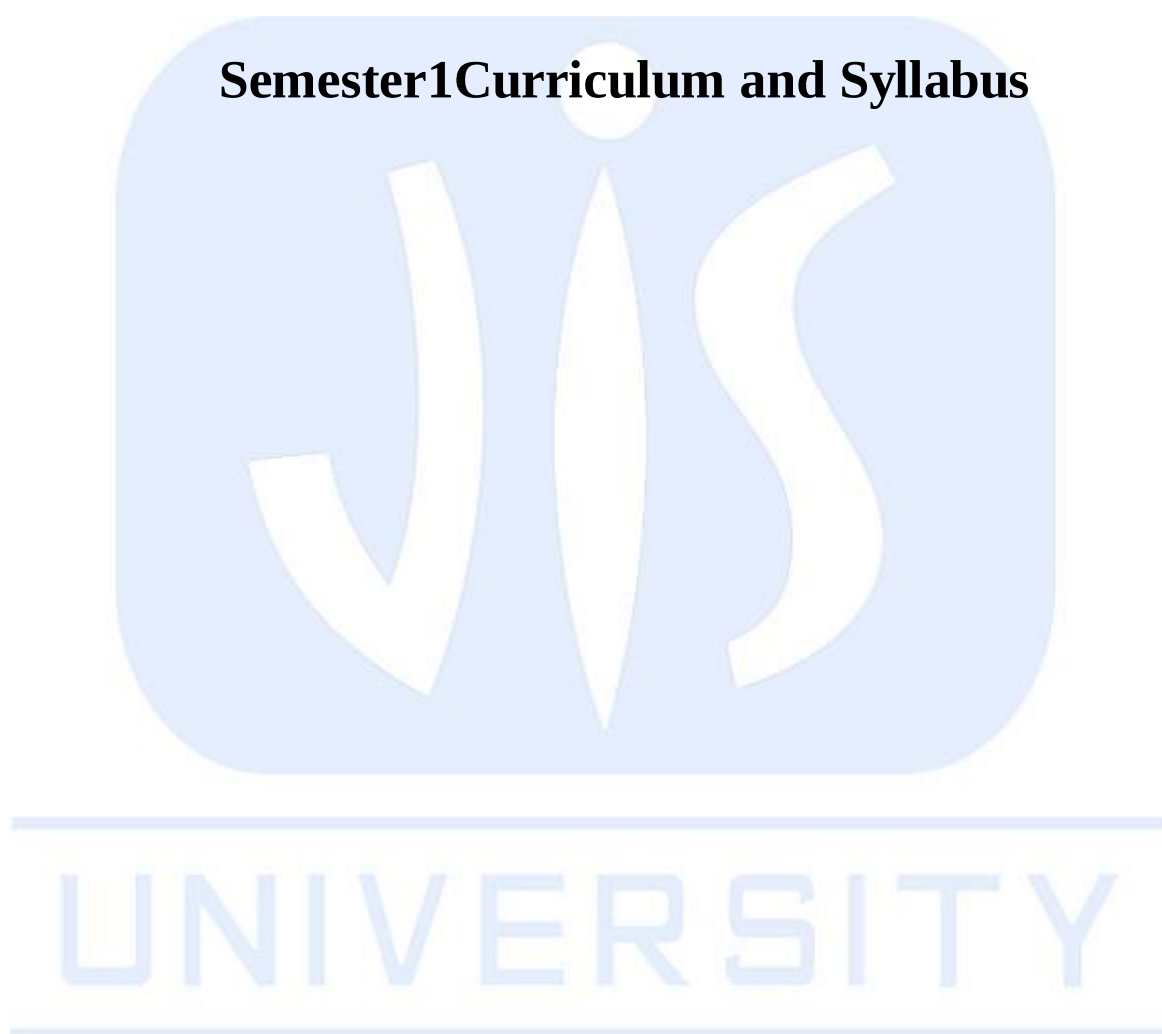
4 th Year 7 th Semester									
Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	YCS7001	Web Technology	3	1	0	4	4
2	ENGG	Major	YCS7002A YCS7002B YCS7002C	Computer Vision Parallel Computing Neural Networks and Deep Learning	3	0	0	3	3
3	ENGG	Major	YCS7003A YCS7003B YCS7003C	Information Retrieval and Data Mining Soft Computing Software Engineering	3	0	0	3	3
4	ENGG	Minor	YCS7004A YCS7004B YCS7004C	Wireless Sensor Network and IoT Information and Coding Theory Data Science	3	0	0	3	3
5	HUM	Minor	YBB7001	Human Resource Development and Organizational Behavior	2	0	0	2	1
B.PRACTICAL									
6	ENGG	Major	YCS7101	Web Technology Laboratory	0	0	3	3	1.5
7	ENGG	Major	YCS7102A YCS7102B YCS7102C	Computer Vision Laboratory Parallel Computing Laboratory Neural Networks and Deep Learning Laboratory	0	0	3	3	1.5
8	ENGG	Major	YCS 7201	Project I	0	0	5	5	2.5
C.MANDATORY ACTIVITIES/COURSES(Non-CGPA)									
9	MC	Mandatory Course	YCS7501	Constitution of India	3	0	0	3	1
10	MC	Mandatory Course	YCS7502	SkillX	0	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses								27	19.5

4 th Year 8 th Semester									
Sl No.	Broad Category	Category	Course Code	CourseTitle	Hours perweek				Credits
					L	T	P	Total	
A.THEORY									
1	ENGG	Major	YCS8001A YCS8001B YCS8001C	Big Data Analytics Block Chain and Crypto Currency Technologies Cyber Security	3	1	0	3	4
2	ENGG	Major	YCS8002A YCS8002B YCS8002C	Pattern Recognition Bioinformatics Robotics	3	0	0	3	4
B.PRACTICAL									
3	PRJ	Skill Enhancement	YCS8201	Project	0	0	18	18	9
4	PRJ	Internship	PR891	Grand Viva	0	0	6	6	3
C.MANDATORY ACTIVITIES/COURSES(Non-CGPA)									
4	MC	Mandatory Course	YED8501	Essence of Indian Knowledge Tradition	0	0	3	3	1
5	MC	Mandatory Course	YCS8502	SkillX	0	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses								33	20

Total Credit =165

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Semester1Curriculum and Syllabus



Course Code	YCS1001			
Course Title	Basic Electrical Engineering			
Category	Engineering Science			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, students will learn about the fundamentals of electrical circuits, focusing on both DC and AC circuits, transformers, and rotating machines.

Course Outcome:

CO1: Understand and remember the working principles of basic electrical circuits, power distribution, and safety measures.

CO2: Analyze the functioning of DC and AC circuits.

CO3: Understand and remember the basic principles of transformers and rotating machines.

CO4: Analyze and evaluate the performance of electrical circuits, transformers, and rotating machines through laboratory experiments and simulations.

CO5: Design basic electrical circuits and systems, considering safety, efficiency, and economic factors.

Course Content:

Module 1: DC Circuits Fundamentals

[9L]

- Electric circuits: Linear circuit, Non-linear circuit, Bilateral circuit, Unilateral circuit, Dependent source, Node, Branch, Active and Passive elements, Kirchhoff's laws, Source equivalence and conversion.
- Network Theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem.

Module 2: AC Circuits Fundamentals

[9L]

- Sinusoidal quantities: Average and RMS values, Peak factor, Form factor, Phase and Phase difference, Concept of phasor diagram, V-I relationship in R, L, C circuits, R-L-C circuits in series and parallel with phasor diagrams, Impedance and Admittance, Impedance triangle and Power triangle, Power factor.
- Three-phase balanced circuits, Concept of three-phase power measurement.

Module 3: Single-Phase Transformer

[5L]

- Single-phase transformer: Idea on constructional parts, Classifications, Working principle. Numerical on EMF equation, Phasor diagram.

Module 4: Electrical Rotating Machines

[8L]

- DC Machines: Constructional features, Classifications, Working principle of Generator and Motor. Simple Numerical on voltage equation.

- Three-phase Induction Motor: Basic concept of Three Phase circuit and Production of Rotating Magnetic Field, Working principle of Three Phase Induction Motor and Torque-Speed Characteristics (concept only).

Module 5: Electrical Installations

[5L]

- Power generation to distribution through overhead lines and underground cables with single-line diagram. Earthing of electrical equipment, Basic accessories: MCB, MCCB, ELCB, SFU, Megger.

Text/Reference Books:

1. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering", Tata-McGrawHill.
2. V. Mittle and A. Mittal, "Basic Electrical Engineering", Tata-McGrawHill.
3. E. Hughes, "Electrical and Electronics Technology", PHI/Pearson Education.
4. C.L. Wadhwa, "Basic Electrical Engineering", Pearson Education.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YMT1001			
Course Title	Engineering Mathematics I			
Category	SCI Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objectives:

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

Course Outcome:

CO1: To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

CO2: The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

CO3: The tool of power series and Fourier series for learning advanced Engineering Mathematics.

CO4: To deal with functions of several variables that is essential in most branches of engineering.

CO5: To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage

Course Content:**Module 1: Basic Calculus:****[6L]**

Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. .

Module 2: Single-variable Calculus (Differentiation):**[6L]**

Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L' Hospital's rule..

Module 3: Sequences and series:**[8L]**

Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series, error estimates..

Module 4: Multivariable Calculus (Differentiation):**[6L]**

Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 5: Multivariable Calculus (Integration):**[10L]**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Gradient, curl and divergence, Theorems of Green, Gauss and Stokes..

Text / Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics (9th Ed)", John Wiley & Sons, 2006.
2. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, 11th

Reprint, 2010.

3. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi, 2008.
4. B. S. Grewal, "Higher Engineering Mathematics (36th Ed)", Khanna Publishers, 2010.
5. N. P. Bali and M. Goyal, "A textbook of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

PO-CO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YPH1001			
Course Title	Engineering Physics			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

The objective of the course is to provide students with a sufficient understanding of physics' foundational ideas and their potential applications. Understanding the fundamentals of physics will enable engineers to better comprehend the instruments and methods employed in the field and lay the groundwork for introducing novel ideas. It can also raise awareness of the crucial part that engineering and science play in the creation of new technologies. Additionally, it provides the required exposure to the practical aspects, which is a vital component of studying the sciences.

Course Outcome:

CO1: To understand and remember the basic principles of Classical Mechanics, Relativistic Mechanics, Quantum Mechanics, Statistical Mechanics, and microscopic phenomena.

CO2: To understand the working principles of laser, optical fiber, and holography amplifier and analyze their various applications to enhance knowledge in modern optics.

CO3: To learn the basic principles of electromagnetic induction, dielectric properties, and magnetic properties of materials.

CO4: To understand and apply knowledge in new technologies.

CO5: To apply the principles of physics to solve engineering problems and analyze real-world phenomena.

Course Content:

Module 1: Mechanics

[8L]

- Representation of vector, scalar, and vector fields, partial derivative of vector, gradient of scalar field, divergence, and curl of vector field.
- Friction, conservation laws, rigid body, moment of inertia, acceleration of rigid body, Mass-energy Equivalence Concept of photon.

Module 2: Quantum Theory

[8L]

- Blackbody Radiation spectrum, Wein's law, Rayleigh-Jeans law, Quantum theory of radiation, Wave mechanics, wave-particle duality, De Broglie waves, Bohr's quantization rules, Phase and group velocities, Davission-Germer Experiment, Heisenberg Uncertainty Principle, Wave function and its significance, Schrodinger's wave equation.

Module 3: Laser, Fiber Optics

[6L]

- Spontaneous and stimulated emission of radiation, Population inversion, Einstein's coefficients, Basic components of laser system, Construction and working of Ruby laser, He-Ne lasers, Laser Applications. Basic ideas of Fiber optics.

Module 4: Statistical Mechanics and Applications

[6L]

- Introduction to Statistical mechanics, Concept of energy levels and energy states. Classical limits of quantum statistics, Concept of Fermi level. Fermi level in metals, Fermi level for intrinsic and extrinsic semiconductors (pictorial representations on temperature dependence and doping concentration viz. p-type, n-type).

Module 5: Electromagnetic Induction

[3L]

- Magnetic flux, Faraday's law of electromagnetic induction, electromotive force, Ampere's circuital law, Maxwell's equation.

Module 6: Dielectrics

[3L]

- Types of dielectric, relation between dielectric constant and electric susceptibility, polarizability, Clausius-Mossotti Equation, application of dielectric materials.

Module 7: Magnetic Properties of Materials

[2L]

- Magnetic flux density, magnetic permeability, magnetic susceptibility, classification of magnetic materials, diamagnetic materials, paramagnetic materials, Curie law.

Text/Reference Books:

1. Beiser, "Concepts of Modern Physics", McGraw Hill India.
2. D.K. Bhattacharya and P. Tandon, "Engineering Physics", Oxford India.
3. Lal and N. Subramanyam, "A Textbook Of Optics", S. Chand & Co.
4. Dominic I. and A. Nahari, "A TextBook of Engineering Physics", Owl Book Publishers.
5. E. Hecht, "Optics", Pearson Education.
6. N. Mehta, "Applied Physics for Engineers", PHI Ltd.
7. J.C Palais, "Fiber Optic Communications", Pearson Education.

8. K. Pandey and S. Chaturvedi, “Engineering Physics”, Cengage Learning.
9. J. Philip, “A textbook of Engineering Physics”, Educational Publishers.
10. B. Premlet, “Engineering Physics”, McGraw Hill India..

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS 1002			
Course Title	Programming for Problem Solving			
Category	ENGG Major			
LTP & Credits	L	T	P	Credit
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

Algorithmic skill is a fundamental skill in modern times, and this course provides the students with the foundations of computational problem solving. The course emphasizes on principles and methods rather than on systems and tools.

Course Outcome:

- CO1:** Understand the basic model of computation
CO2: Apply algorithmic thinking to understand, and solve problems
CO3: Design and implement algorithms for a given problem
CO4: Implement algorithms using a high-level programming language
CO5: Analyze and evaluate algorithms for efficiency and correctness

Course Content:

Module 1: Problem Solving and Algorithmic Thinking [6L]

Overview - problem definition, logical reasoning. Flowcharts - symbols used, examples. Algorithm - definition, practical examples, properties, representation, algorithms vs programs. Elementary concepts about time complexity

Module 2: Introduction to Computation [10L]



Introduction to Computing – Computer Systems-Hardware and Software, Computer Languages, Algorithm, Flowchart, Representation of Algorithm and Flowchart with examples. Introduction to C– History of C, Features of C, Structure of C Program, Character Set, C Tokens-Keywords, Identifiers, Constants, Variables, Data types, Operators.

.Module 3: Function of C

[8L]

Functions-Designing Structured Programs, Types of Functions-User defined functions, Standard functions, Categories of functions, Parameter Passing techniques, Recursion.

Module 4: Array and String

[8L]

Arrays- Declaration and Initialization, One dimensional Array, Two dimensional Arrays. Strings- Declaration and Initialization, String Input / Output functions, String manipulation functions.

Module 5: Pointers and Structure

[9L]

Pointers- Introduction, Definition and Declaration of pointers, address operator, Pointer variables, Pointers with Arrays. Structures- Introduction, Declaration and Initialization, Array of Structures, Unions.

Module 5: File Handling in C

[6L]

Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling), Positioning functions.

Text/Reference Books:

1. D.D. Riley and K. A. Hunt, "Computational Thinking for the Modern Problem Solver", CRC Press.
2. P. F. Luccio, "Computational Thinking: First Algorithms, then Code" Springer.
3. S. S. Sastry, "Introductory Methods of Numerical Analysis" Prentice-Hall of India.
4. R. G. Dromey, "How to Solve it by Computer" Prentice-Hall.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YED1005			
Course Title	Indian Knowledge System			
Category	Core			
LTP & Credits	L	T	P	Credits
	1	1	0	1
Total Contact Hours	24 hrs			
Pre-requisites	None			

Learning Objective(s):

To facilitate students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of the knowledge system. To make students understand traditional knowledge and analyze it and apply it to their day-to-day life.

Course Outcomes:

- CO1: Provide an overview of the concept of the Indian Knowledge System and its importance.
 CO2: Appreciate the need and importance of protecting traditional knowledge.
 CO3: Recognize the relevance of Traditional knowledge in different domains.
 CO4: Establish the significance of Indian Knowledge systems in the contemporary world.
 CO5: Evaluate the impact of Indian Knowledge Systems on global perspectives.

Course Content:

Module 1: Introduction to Indian Knowledge Systems (IKS): [8L]

Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.

Module 2: Traditional Knowledge in Humanities and Sciences: [8L]

Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.

Module 3: Traditional Knowledge in Professional domain: [8L]

Town planning and architecture- Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

Text / Reference Books:

1. Introduction to Indian Knowledge System - concepts and applications, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-9391818-21-0
2. Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230
3. Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS 1103			
Course Title	Workshop/Manufacturing Practices Laboratory			
Category	ENGG Skill Enhancement			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Physics & Mathematics (10+2 Level)			

Course Outcomes:

After successful completion of this course, learners will be able to:

CO1: Identify and operate various hand tools related to a variety of manufacturing operations.

CO2: Safely fabricate simple components with their own hands.

CO3: Gain practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.

CO4: Produce small devices of their interest for project or research purposes.

CO5: Apply safety standards and regulations in workshop environments to ensure the well-being of oneself and others.

Course Content:

(i) Theoretical discussion & videos: 3P

1. Manufacturing Methods - casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry

4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic molding & Glass Cutting

(ii) Workshop Practice:

Module 1: Machine shop 6P Typical jobs that may be made in this practice module: i. To make a pin from a mild steel rod in a lathe. ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2: Fitting shop 6P Typical jobs that may be made in this practice module: i. To make a Gauge from MS plate.

Module 3: Carpentry 6P Typical jobs that may be made in this practice module: i. To make wooden joints and/or a pattern or like.

Module 4 : Welding shop (Arc welding 3P + gas welding 3P) 3P Typical jobs that may be made in this practice module: i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metal arc welding. ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 : Electrical & Electronics 3P House wiring, soft soldering

Module 6: Smithy 3P Typical jobs that may be made in this practice module: R21 B. Tech (ME) i. A simple job of making a square rod from a round bar or similar. For further study (Optional)

Module 7: Casting 3P Typical jobs that may be made in this practice module: i. One/ two green sand molds to prepare, and a casting be demonstrated.

Module 8: Plastic molding & Glass Cutting 3P Typical jobs that may be made in this practice module: i. For plastic molding, making at least one simple plastic component should be made. ii. At least one sample shape on glass should be made using laser cutting machine. Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K., and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.

4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course code	YCS1102			
Course Title	Programming for Problem solving Laboratory			
Category	ENGG Major			
LTP & Credits	L	T	P	Credit
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Basic Understanding of Computer			

Learning Objective:

The course is oriented to those who want to advance structured and procedural programming understanding and to improve C programming skills. The major objective is to provide students with an understanding of code organization and functional hierarchical decomposition using complex data types.

Course Outcomes:

CO1: Learn and understand the DOS system commands and familiarize with C programming environment.

CO2: Learn and translate the algorithms into simple programs and understand the flowchart design and test.

CO3: Understand and implement conditional branching, iteration and recursion.

CO4: Apply and analyze various C programs with Arrays, Pointers, Structures, Union along with functions.

CO5: Apply programming to solve matrix addition and multiplication problems and understand the file handling.

Course Content:

Suggestive List of Experiments:

1. Familiarization with basic DOS commands and programming design with the help of Flowcharts Using Raptor. [1 day]

2. Familiarization with C programming environment, Variable types and type Conversions, Simple Computational problems using arithmetic expressions. [1 day]
3. Branching and logical expressions, Problems involving if-then-else structures. [1 day]
4. Loops, while and for loops, Iterative problems e.g., sum of series, patterns print. [2 days]
5. 1D Arrays: searching, sorting, 1D Array manipulation, 2D arrays and Strings, Matrix problems, String operations. [2 days]
6. Functions, call by value, Simple functions implementations, function recursion. [2 days]
7. Pointers, structures and dynamic memory allocation, Union. [2 days]
8. File handling, file reading, writing, copying etc. [1 day]

Text/Reference Books:

1. B. W. Kerninghan & D. M. Ritchie, "The C Programming Language (16th Ed.)", PHI/Pearson Education.
2. Y. Kanetkar, "Let us C (15th Ed.)", BPB Publication.
3. E. Balagurusamy, "Programming in ANSI C (15th Ed.)", Tata-McGraw Hill.
4. K. R. Venugopal & S. R. Prasad, "Mastering C (7th Ed.)", Tata-McGraw Hill.
5. R. Thareja, "Introduction to C Programming (4th Ed.)", Oxford University Press.

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YPH1101			
Course Title	Engineering Physics Laboratory			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

The objective of this course is to revise the basic concepts of physics through a standard set of experiments to correlate them with the corresponding theory.

Course Outcomes:

CO1: To discover an idea of different measurements and errors.

CO2: To understand and apply basic laws of physics and experiments.

CO3: To practice and generate experimental skills in different areas of physics and applications.

CO4: To analyze experimental data using appropriate statistical methods and tools to draw meaningful conclusions and make predictions.

CO5: To communicate experimental procedures, observations, and results effectively through written reports and oral presentations.

Course Content:

Suggestive List of Experiments:

1. General idea about Measurements and Errors: i) Error estimation using Slide calipers/Screw-gauge/traveling microscope for one experiment. ii) Proportional error calculation using Carey Foster Bridge. [2 days]
2. Determination of wavelength of light by Newton's ring method. [1 day]
3. Determination of wavelength of light by Laser diffraction method. [1 day]
4. Determination of Planck's constant using photoelectric cell. [1 day]
5. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment. [2 days]
6. Determination of Stefan's constant. [1 day]
7. Determination of bandgap of a semiconductor. [1 day]
8. Study of dispersive power of material of a prism. [1 day]
9. Measurement of nodal and antinodal points along transmission wire and measurement of wavelength. [1 day]
10. Determination of wavelength of light by Fresnel's bi-prism method. [1 day]

Text/Reference Books:

1. B.L. Flint and H.T. Worsnop, "Advanced Practical Physics for Students", Asia Publishing House.
2. M. Nelson and J.M. Ogborn, "Advanced Level Physics Practicals", Heinemann Educational Publishers.
3. S. Panigrahi and B. Mallick, "Engineering Practical Physics", Cengage Learning.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS1101			
Course Title	Basic Electrical Engineering Laboratory			
Category	Engineering Science			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, students will learn about the basic electrical components, machinery, instruments, and safety measures.

Course Outcomes:

CO1: Identify and apply common electrical equipment and instruments.

CO2: Develop electric networks using various components and analyze the circuit behavior.

CO3: Apply and analyze the basic characteristics of transformers and electrical machines.

CO4: Demonstrate an understanding of the characteristics and operation of different types of electrical machines.

CO5: Analyze and interpret data from electrical experiments, draw conclusions, and make recommendations based on the findings.

Course Content:

List of Experiments:

1. Basic safety precautions – Earthing, Introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real-life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten, and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of a single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing, and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on a single-phase Energy Meter.
13. Innovative experiments.

Text/Reference Books:

1. D.P. Kothari and I.J. Nagrath, "Basic Electrical Engineering," Tata-McGraw Hill.
2. V. Mittle and A. Mittal, "Basic Electrical Engineering," Tata-McGraw Hill.
3. E. Hughes, "Electrical and Electronics Technology," Pearson.
4. C.L. Wadhwa, "Basic Electrical Engineering," Pearson Education.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO- 1	PSO- 2	PSO- 3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



UNIVERSITY

Semester 2 Curriculum and Syllabus



Course Code	YCS2001			
Course Title	Basic Electronics			
Category	SCI Multi Displ			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, students will learn about the fundamental behavior and principle of operations of various electronic devices and circuits. At the end of the course, students will be able to design useful electronic subsystems like rectifiers, amplifiers, etc.

Course Outcome:

- CO1:** To understand and remember the principle of operation of semiconductor devices.
- CO2:** To understand and analyze the operations of P-N junction diodes, bipolar and field-effect transistors, and solve design problems.
- CO3:** To understand and remember the principle of working of operational amplifiers and demonstrate its various applications.
- CO4:** Design and analyze electronic circuits incorporating semiconductor devices and operational amplifiers to meet specified requirements.
- CO5:** Troubleshoot and optimize electronic circuits using diagnostic tools and techniques.

Course Content:

Module 1: Fundamentals of Semiconductor

[6L]

- Conductors, Insulators, and Semiconductors
- Energy band diagrams
- Fermi Dirac function, Fermi level
- Intrinsic and Extrinsic (p-type and n-type) semiconductors
- Drift and Diffusion current
- Mass action law
- Conductivity in semiconductor
- Einstein relationship in semiconductor
- Numerical problems

Module 2: P-N Junction Diode and its Applications

[8L]

- P-N junction diode, Characteristics, and parameters
- Diode equation, V-I characteristics
- P-N junction breakdown: conditions, avalanche, and zener breakdown
- Zener diode and characteristics
- Diode half-wave and full-wave rectifiers (centre tapped and bridge) circuits and operation, ripple factor, efficiency, reduction of ac ripples using filter circuit (Qualitative analysis)
- Design of diode clipper and clamper circuit

- Application of Zener diode in regulator circuit
- Numerical problems

Module 3: Bipolar Junction Transistor

[6L]

- BJT operation: PNP and NPN transistors
- Transfer characteristics, Current conduction mechanism
- Common Emitter, Common Base, Common Collector configurations and Static characteristics
- Junction biasing condition for active, saturation, and cut-off modes
- DC load line and Quiescent point
- BJT biasing, BJT as an amplifier
- Numerical problems

Module 4: Field Effect Transistor

[6L]

- Classification of field-effect transistors: JFET, MOSFET
- Operating principle of JFET
- Drain and Transfer characteristics of JFET (n-channel and p-channel)
- CS, CG, CD configurations
- Relation between JFET parameters
- FET as an amplifier
- E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p-channel)
- Numerical Problems

Module 5: Feedback and Operational Amplifier

[8L]

- Concept of feedback: Positive and Negative feedback, Gain with feedback, Feedback topologies
- Operational Amplifier: Ideal characteristics, Non-ideal characteristics of op-amp – offset voltages, bias current, offset current, slew rate, CMRR, and bandwidth
- Inverting and Non-inverting amplifier
- Concept of virtual ground and virtual short
- Applications of op-amp: Adder, Differential Amplifier, Differentiator, Integrator
- Numerical problems

Module 6: Electronic Instruments and Measurements

[2L]

- Basics of measurement
- Cathode-Ray Oscilloscope and Digital-Storage Oscilloscope
- Measurement of voltage, frequency, and phase
- Signal generators and analytical instruments

Text/Reference Books:

1. D. Chattopadhyay and P. C. Rakshit, "Electronics Fundamentals and Applications", New Age International Publishers
2. J. Millman, C. Halkias, and C. D. Parikh, "Integrated Electronics", McGraw-Hill Education
3. D. A. Bell, "Electronic Devices and Circuits", Oxford University Press
4. D. P. Kothari and I. J. Nagrath, "Basic Electronics", McGraw-Hill Education
5. J. D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS2002				
Course Title	Data Structures				
Category	Programme Core				
LTP & Credits	L	T	P	Credits	
	3	1	0	3	
Total Contact Hours	48				
Pre-requisites	Basic Programming				

Learning Objective:

In this course, students will be taught about the significance of non-linear data structures with respect to the access and organization of data, various algorithmic approaches to write programs to solve problems in different engineering domains by using different data structures, merits and demerits of altered algorithms in terms of time-complexity.

Course Outcome:

CO1: To differentiate how the choices of data structure and algorithm methods impact the performance of a program.

CO2: To solve problems based on different data structures and also write programs.

CO3: To identify appropriate data structure and algorithmic methods in solving a problem.

CO4: To discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing.

CO5: To compare and contrast the benefits of dynamic and static data structures implementations.

Course Content:

Module 1: Introduction of Data Structure

[8L]

- Concepts of data structures, Abstract Data Type.
- Algorithms and programs, basic idea of pseudo-code, Properties of an algorithm.
- Algorithm efficiency and analysis, time and space analysis of algorithms – Order notations.
- Array: Different representations – row major, column major.
- Sparse matrix – its implementation and usage, Array representation of polynomials.

Module 2: Linear Data Structure

[14L]

- Stack and its implementations (using array and linked list).
- Applications (Infix, Prefix, and Postfix with their conversions, Postfix Evaluation).
- Queues, circular queue, de-queue.
- Implementation of queue- linear and circular (using array and linked list).

- Recursion: Principles of recursion - use of stack, tail recursion. Applications - The Tower of Hanoi, Eight-queen problem.
- Linked List: Singly linked list – operations, doubly linked list – operations.
- Circular linked list – operations, Linked list representation of polynomial and applications

Module 3: Nonlinear Data Structure

[18L]

- Trees: Basic terminologies, forest, tree representation (using array and linked list).
- Binary trees - binary tree traversal (pre-, in-, post- order).
- Threaded binary tree – operations.
- Binary search tree- operations (creation, insertion, deletion, searching).
- Concept of Max-Heap and Min-Heap (creation, deletion).
- Height balanced binary tree – AVL tree (insertion, deletion with examples only).
- Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge).
- Minimal spanning tree – Prim’s algorithm, Kruskal’s algorithm (basic idea of greedy methods).

Module 4: Searching and Sorting

[8L]

- Sorting Algorithms: Bubble sort, Insertion sort, Selection sort – with the notion of complexity.
- Quick sort, Merge sort – with complexity, Radix sort – with complexity.
- Searching: Sequential search, Binary search, Interpolation Search– with complexity.
- Hashing: Hashing functions, Collision resolution techniques.

Text/Reference Books:

1. E. Horowitz, S. Sahni and S. Anderson-Freed, “Fundamentals of Data Structures of C”, Universities Press.
2. S. Lipschutz, “Data Structures”, Tata McGraw Hill Education (India) Private Limited.
3. A. M. Tanenbaum, “Data Structures in C”, Pearson.
4. R. Thareja, “Data Structures Using C”, Oxford.
5. A.K. Rath, A. K. Jagadev, “Data Structure Using C”, Scitech Publications.
6. T. H. Coreman, “Introduction to Algorithms”, MIT Press.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS2003			
Course Title	Mathematics II			
Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	None			

Learning Objective:

In this course the students will learn about the Mathematics fundamental necessary to formulate, solve and analyse engineering problems.

Course Outcomes:

CO1: To use mathematical tools to evaluate multiple integrals and vector integrals.

CO2: To apply effective mathematical tools for the solutions of ordinary differential equations that model physical processes.

CO3: To understand the properties of Laplace Transform to evaluate multiple integrals and their usage

CO4: To understand the concept of Laplace transform to solve ordinary differential equations.

CO5: Apply mathematical concepts and techniques to analyze and solve engineering problems involving double and triple integration, ordinary differential equations, and Laplace transforms, demonstrating proficiency in mathematical modeling and problem-solving skills.

Course Content:

Module 1: Matrices

[6L]

Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices.

Module 2: First order ordinary differential equations:

[6L]

Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders:

[8L]

Second order linear differential equations with variable coefficients: Euler-Cauchy equations, solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation:

[8L]

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration:

[8L]:

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour

Text /Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
2. 2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008. 3.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
4. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCH2001			
Course Title	Engineering Chemistry			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

The objective of the Chemistry-I is to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry will understand and explain scientifically the various chemistry related problems in the industry/engineering field. The student will be able to understand the new developments and breakthroughs efficiently in engineering and technology. The introduction of the latest (R&D oriented) topics will make the engineering student upgraded with the new technologies.

Course Outcome:

CO1: Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.

CO2: Rationalize bulk properties and processes using thermodynamic considerations.

CO3: Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

CO4: Rationalize periodic properties such as ionization potential, electro negativity, oxidation states and electro negativity.

CO5: List major chemical reactions that are used in the synthesis of molecules.

Course Contents:

Module 1: Atomic and molecular structure [12L]

Schrodinger equation. Particle in box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and atomicity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module 2: Spectroscopic techniques and applications [6L]

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibration and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.

Module 3: Intermolecular forces and potential energy surfaces [4L]

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H₃, H₂F and HCN and trajectories on these surfaces.

Module 4: Use of free energy in chemical equilibrium [6L]

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibrium. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties [4L]

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro negativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

Module 6: Stereochemistry [4L]

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Text /Reference Books:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins (vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YED2001				
Course Title	Professional Communication				
Category	Humanities				
LTP & Credits	L	T	P	Credits	
	1	1	0	1	
Total Contact Hours	24				
Pre requisites	None				

Learning Objective:

In this course, the students will develop communicative competence in English so as to make them industry-ready, with special emphasis on knowledge in grammar and English writing.

Course Outcome:

CO1: To learn how to employ communication skills in the workplace

CO2: To understand and learn about the use of the different elements of English

CO3: To develop requisite skills for effective reading and comprehension of texts

CO4: To learn how to compose formal, written communication

CO5: To enhance listening skills for effective communication.

Course Content:

Module 1: Communication in a Globalized World

[4L]

Introduction; meaning of communication; five stages of communication; formal and informal communication; verbal and non-verbal communication; role of body language in communication; barriers to effective communication; prejudice and lack of sensitivity in communication; gender/culture neutrality.

Module 2: Functional Grammar

[8L]

Articles and prepositions. Direct and indirect verbs, subject-verb agreement. Tense and voice, sentences: simple, complex and compound; direct and indirect speech..

Module 3: Reading Comprehension

[6L]

Reading purposes and skills: skimming, scanning and intensive reading, reading comprehension: fictional and non-fictional prose, one-word substitution and sentence making.

1. "Where the Mind is without Fear" by Rabindranath Tagore
2. "Out of Business" by R.K. Narayan

Module 4: Writing Skills [

6L]

Paragraph, formal letters, emails, job applications, order and complaint letter, importance of punctuation in writing.

Text/Reference Books:

1. Wren and Martin (Revised by N. D. V. Prasada Rao), "High School English Grammar and Composition", S. Chand Publishing.
2. S. A. Beebe and T. P. Mottet, "Business and Professional Communication – Principles and Skills and Leadership" Pearson Education.
3. Sethi and B. Adhikari, "Business Communication" Tata McGraw-Hill.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YED2101			
Course Title	Professional communication Laboratory			
LTP & Credits	L	T	P	Credits
	0	0	2	1
Total Contact Hours	24			
Pre-requisites	None			

Learning Objective:

In this laboratory course, students will be exposed to the need for English in the workplace and equipped with good language skills, communication skills, and soft skills.

Course Outcome:

CO1: Apply different skills of technical communication in English.

CO2: Use correct pronunciation when speaking English.

CO3: Use appropriate techniques for effective and active listening.

CO4: Learn to express ideas clearly and coherently in professional settings.

CO5: Demonstrate effective verbal and non-verbal communication skills in various professional scenarios, including presentations, meetings, and interviews

Course Content:

Suggestive List of Experiments:

1. Learn about phonetics and pronunciation guide (Introduction of phonetics and phonetic table, tongue and lip movements for vowels and consonants, monophthongs/diphthongs, voiced/unvoiced, aspirated/unaspirated, minimal pairs, syllables, stress, and intonation). [4 Days]
2. Training on listening and comprehension (Active listening and its techniques, academic listening versus business listening, listening activities: answering questions, form filling, summarizing news bulletin, presentation, video clip, lecture, story). [6 Days]
3. Training on speaking skills (Basic parameters of speaking, fluency-focused activities: JAM, conversational role plays, speaking using a picture, group discussions, and personal interviews). [6 Days]

4. Laboratory project work (Making a 5-minute animation video with voiceover OR making a 10-minute documentary film). [8 Days]

Text/ Reference Books:

1. P. Ladefoged, "A Course in Phonetics", Harcourt Brace Jovanovich College Publishers.
2. J. Sullivan, "Simply Said: Communicating Better at Work and Beyond", Wiley.
3. N. Leonardo, "Active Listening Techniques: 30 Practical Tools to Hone your Communication Skills", Rockridge Press.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS2101			
Course Title	Basic Electronics Laboratory			
Category	ENGG Skill Enhancement			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

1. To prepare the students to have a basic knowledge of active and passive components.
2. To develop the ability to measure signals using a multimeter, CRO.
3. To understand the characteristics of proper biasing for BJT and FET.
4. To encourage the development of circuits using diodes, transistors, FETs, and OPAMPs.

Course Outcome:

CO1: To study and evaluate the characteristics of basic electronic components (Diode, BJT, FET).

CO2: To demonstrate the working of CRO, Function Generator, Digital Multimeter, and D.C. power supply.

CO3: To sketch the V-I characteristics of p-n junction diode, Zener diode, BJT.

CO4: To construct the rectifier circuit using diode and Inverting, Non-inverting amplifiers Circuit using Op-Amp.

CO5: To determine the characteristics parameters of Op-Amp.

Course Content:

List of Experiments:

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT). [3 days]
2. Familiarization with measuring and testing equipment like Digital Multimeter, CRO, Signal generator, and Power Supply. [2 days]
3. Study of V-I characteristics of Junction diode. [1 day]
4. Study of V-I characteristics of Zener diode. [1 day]
5. Study of Half wave and Full wave rectifier. [2 days]
6. Study of V-I characteristics of BJT. [1 day]
7. Study of an operational amplifier chip and analyze its functionality. [2 days]
8. Design of non-inverting and inverting amplifier using operational amplifier. [2 days]
9. Design of adder, differential amplifier using operational amplifier. [2 days]
10. Verification of the truth table of basic logic gates using IC. [1 day]
11. Innovative Experiment. [1 day]

Text/Reference Books:

1. J. Millman, C. Halkias, and C. D. Parikh, "Integrated Electronics", McGraw-Hill Education.
2. D. A. Bell, "Electronic Devices and Circuits", Oxford University Press.
3. D. P. Kothari and I. J. Nagrath, "Basic Electronics", McGraw-Hill Education.
4. J. D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	1	2	2	1	2	2	-	2
CO2	3	2	1	2	2	-	-	1	2	2	1	2	3	3	3
CO3	3	3	1	1	2	-	-	1	2	1	1	2	3	3	3
CO4	3	3	3	2	2	1	1	1	3	2	2	3	3	3	3
CO5	3	2	1	1	-	-	-	-	1	1	1	2	2	-	2

Course Code	YCS2102			
Course Title	Data Structures Laboratory			
Category	Programme Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Fundamentals of Programming			

Learning Objective:

In this course, students will learn about implementing different algorithmic approaches in C programs using non-linear and linear data structures to solve problems in various engineering domains.

Course Outcome:

CO1: Choose appropriate data structures for specified problem definitions.

CO2: Compare operations such as searching, insertion, deletion, and traversing mechanisms on various data structures.

CO3: Explain practical applications of data structures.

CO4: Analyze how to store, manipulate, and arrange data efficiently.

CO5: Implement various data structures using arrays and linked lists.

Course Content:

1. Experiments on Arrays [1 day]
 - Addition and Multiplication of Arrays
 - Implementation of Sparse Matrices
2. Experiments on Abstract Data Types [2 days]
 - Implementation of stack using Array
 - Applications of stack: infix to postfix conversion, expression evaluation
3. Experiments on Linked List [2 days]
 - Implementation of linked lists and its operations: insertion, deletion, and reverse
 - Implementation of stacks and queues using linked lists
 - Polynomial addition and polynomial multiplication
4. Experiments on Searching and Sorting [2 days]
 - Searching: Linear Search, Binary Search
 - Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, and Heap Sort
5. Experiments on Non-linear Data Structures [2 days]
 - Traversals of binary tree, Binary Search Tree (BST), Threaded binary tree
 - Height-balanced binary tree: AVL tree (insertion, deletion)
 - B-Trees: insertion, deletion
6. Experiments on Hashing [1 day]

- Implementation of Hash tables and its operations: searching, inserting, and deleting, handling collisions

7. Innovative Experiments [2 days]

- Case study of solving complex problems from various engineering domains using suitable data structures (e.g., mesh analysis in electrical circuits, event-driven simulation, etc.).

Text/Reference Books:

1. C. E. Balagurusamy, "Data Structures using C", McGraw Hill.
2. E. Horowitz, S. Sahni, and S. Anderson-freed, "Fundamentals of Data Structures of C", Universities Press.
3. A. K. Sharma, "Data Structures using C", Pearson.
4. R. Thareja, "Data Structures using C", Oxford University Press.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS2103			
Course Title	Engineering Graphics & Design Laboratory			
Category	PC			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None/IfAny			

Learning Objective:

The learning objectives of engineering graphics typically include developing skills and knowledge related to the visualization, interpretation, and communication of engineering designs.

Course Outcomes (COs):

After attending the course, students would:

CO1: Get introduced to Engineering Graphics and visual aspects of design.

CO2: Know and use common drafting tools with the knowledge of drafting standards.

CO3: Able to apply computer-aided drafting techniques to represent line, surface, or solid models in different engineering viewpoints.

CO4: Able to produce part models; carry out assembly operations and show the working procedure of a designed project work using animation.

CO5: Demonstrate proficiency in using computer-aided design (CAD) software to create and modify engineering drawings, including 2D and 3D models, with an understanding of industry standards and practices.

Course Content:

List of Drawings:

- **Traditional Engineering Graphics:** Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Modules:

Module 1: Introduction to Engineering Drawing

- Principles of Engineering Graphics and their significance.
- Usage of Drawing instruments.
- Lines, lettering, Dimensioning.
- Scales – Plain, Diagonal, and Vernier Scales.

Module 2: Geometrical Construction and Curves

- Construction of polygons, Parabola, Hyperbola, Ellipse, Cycloid, Archimedean Spiral, and Involute (square & circle).

Module 3: Projection of Points, Lines, Surfaces

- Orthographic projection - 1st and 3rd angle projection.
- Projection of lines and surfaces – Hexagon.

Module 4: Projection of Solids

- Cube, Pyramid, Prism, Cylinder, Cone.

Module 5: Drawing Isometric view from Orthogonal / Sectional views of Simple Solid Objects

- Principles of Orthographic Projections.
- Conventions.
- Projections of Points and lines inclined to both planes.
- Auxiliary Views.
- Isometric Views of lines, Planes, Simple, and compound Solids.
- Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 6: Sections and Sectional Views of Right Angular Solids

- Full and half-sectional views of solids.

Module 7: Development Of Surfaces

- Prism, Cylinder, Cone.

Module 8: Computer-Aided Drafting (Using AutoCAD and/or similar softwares)

- Introduction: Cartesian and Polar coordinate system, Absolute and Relative coordinates.
- Basic editing commands: Line, Point, Trace, Rectangle, Polygon, Circle, Arc, Ellipse, Polyline.
- Editing methods.
- Basic object selection methods, Window and crossing window, Erase, Move, Copy, Offset, Fillet, Chamfer, Trim, Extend, Mirror.
- Display commands: Zoom, Pan, Redraw, Regenerate.
- Simple dimensioning and text.
- Simple exercises.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House.
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers.

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House.
2. Agrawal B. & Agrawal C.M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
4. Narayana, K.L. & P Kanniah (2008), Textbook on Engineering Drawing, Scitech Publishers.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCH2101				
Course Title	Engineering Chemistry Laboratory				
Category	Basic Science				
LTP & Credits	L	T	P	Credits	
	0	0	3	1.5	
Total Contact Hours	36				
Pre-requisites	None				



Learning Objective:

The students will learn to estimate rate constants of reactions from concentration of reactants/products as a function of time. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc. Synthesize a small drug molecule and analyze a salt sample.

Course Outcome:

- CO1:** To understand and apply basic chemical principles
CO2: To Perform experiments and analyze data
CO3: Apply chemical knowledge to engineering applications.
CO4: To Develop experimental techniques and problem-solving skills.
CO5: Understand the importance of chemical properties and reactions in various engineering fields.

Course Contents:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Chemical analysis of a salt
10. Lattice structures and packing of spheres
11. Models of potential energy surfaces
12. Chemical oscillations- Iodine clock reaction
13. Determination of the partition coefficient of a substance between two immiscible liquids
14. Adsorption of acetic acid by charcoal
15. Use of the capillary viscosimeters to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg . Laboratory Outcomes

Text /Reference Books:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins (vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition <http://bcs.whfreeman.com/vollhardtschore5e/default.asp>

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS2505			
Course Title	LIFE SKILLS			
Category				
LTP & Credits	L	T	P	Credits
	0	0	1	1
Total Contact Hours	30			
Pre-requisites	None			

Learning Objective:

Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underlie personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Course Outcomes:

After the completion of the course, the student will be able to:

- **CO1:** Define and identify different life skills required in personal and professional life.
- **CO2:** Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
- **CO3:** Explain the basic mechanics of effective communication and demonstrate these through presentations.
- **CO4:** Take part in group discussions for goal-setting, decision-making, and problem-solving, and work effectively in teams to achieve common goals.
- **CO5:** Use appropriate thinking and problem-solving techniques to solve new problems.

Course Content:

Module 1:[6L]

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, Problem solving, Effective communication, Interpersonal relationships, Coping with stress, Coping with emotion.

Life Skills for Professionals: Positive thinking, Right attitude, Attention to detail, Having the big picture, Learning skills, Research skills, Perseverance, Setting goals and achieving them, Helping others, Leadership, Motivation, Self-motivation, and motivating others, Personality development, IQ, EQ, and SQ.

Module 2:[7L]

Self-awareness: Definition, need for self-awareness; Coping with stress and emotions, Human values, tools and techniques of SA: Questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training.

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values, and Ethics: Integrity, Civic Virtue, Respect for others, Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Time management, Co-operation, Commitment, Empathy, Self-confidence, Character, Spirituality, Avoiding procrastination, Sense of engineering ethics.

Module 3:[5L]

21st Century Skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right Brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in Problem Solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections, Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4:[6L]

Group and Team Dynamics: Introduction to Groups: Composition, formation, cycle, thinking, clarifying expectations, problem solving, consensus, dynamics techniques, Group vs Team, Team dynamics, Virtual teams. Managing team performance and managing conflicts, Entrepreneurship

Case Studies: Students analyze real-world case studies to apply life skills concepts to practical problems.

Module 5:[6L]

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of leadership, traits, styles, VUCA leadership, levels of leadership, transactional vs. transformational leaders, leadership grid, effective leaders.

Self-Assessment Quizzes: Students complete self-assessment quizzes to reflect on their strengths, weaknesses, values, and goals.

Text Books

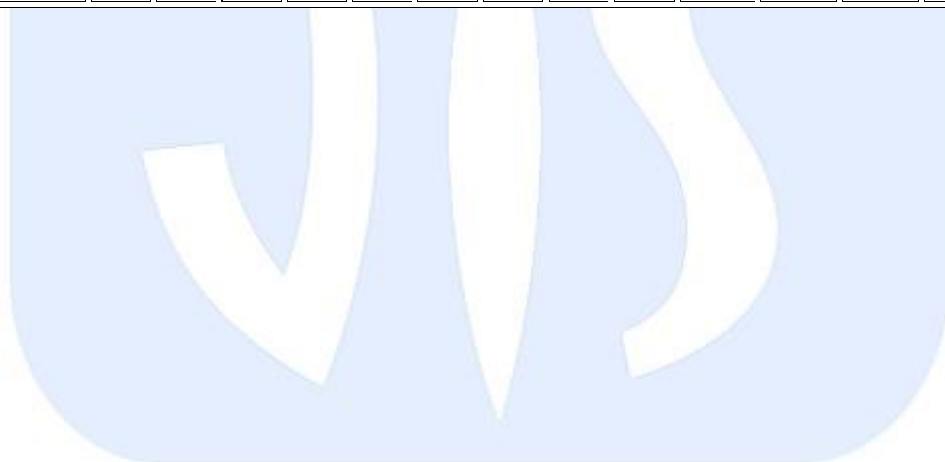
1. BarunK.Mitra,“Personality Development & Soft Skills”, Oxford Publishers, Third impression,2017.

Reference Books:

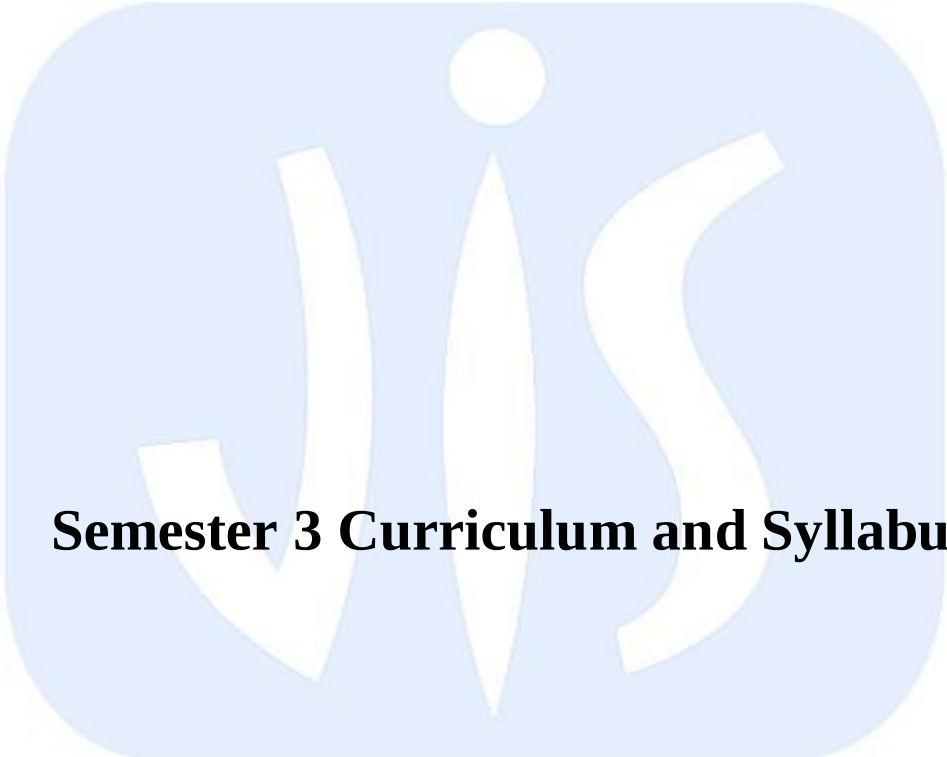
1. ShivKhera,“You Can Win”, MacmillanBooks,NewYork,2003.
2. ICT Academy of Kerala,"Life Skills for Engineers ", McGraw-Hill Education (India) Private Ltd.,2016.
3. Caruso, D. R. and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership”,JohnWiley & Sons, 2004.
4. Kalyana, “Soft Skill for Managers”; First Edition;Wiley Publishing Ltd,2015.
5. Larry James,“The First Book of Life Skills”; FirstEdition,EmbassyBooks,2016.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	-	-	-	-	-	2	-	1	2	2	1	3	-	-	-
CO2	-	-	-	-	-	1	-	-	3	-	-	2	-	-	-
CO3	-	-	-	-	-	1	-	-	1	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-
CO5	-	3	2	1	-	-	-	-	-	-	-	-	-	-	-



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Semester 3 Curriculum and Syllabus

UNIVERSITY

Course Code	YCS3005			
Course Title	Probability and Statistics			
Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, students will learn about the basic knowledge of probability and statistics. At the end of the course, the students will be able to solve different real-life problems in the field of artificial intelligence, data science, etc.

Course Outcome:

- CO1: To explain and demonstrate the distinctive characteristics of probability distribution.
- CO2: To analyze the probability of real-world uncertain phenomena by identifying probability distribution that fits the phenomena.
- CO3: To explain and demonstrate the distinctive characteristics of statistics.
- CO4: To apply and analyze the uses and limitations of statistical analysis.
- CO5: Apply probability and statistical concepts to solve problems in artificial intelligence, data science, and other relevant fields.

Course Content:

Module 1: Basic Probability: [12L]

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Module 2: Continuous Probability Distributions: [4L]

Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Module 3: Bivariate Distributions: [4L]

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 4: Basic Statistics: [8L]

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Module 5: Applied Statistics:

[8L]

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Text/Reference Books:

1. E.Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons.
2. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers.
3. N.G.Das, "Statistical Methods (Combined Volume)", Tata-McGrawHill.
4. R.GargandC.Prasad, "Advanced Engineering Mathematics", Khanna Publishers.
5. S.Ross, "A First Course in Probability", Pearson Education India.
6. W.Feller, "An Introduction to Probability Theory and its Applications, Vol.1", Wiley.
7. J.E.FreundandR.E.Walpole, "Mathematical Statistics", Prentice Hall.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3

Course Code	YCS3001			
Course Title	Digital Logic and Electronics			
Category	ProfessionalCore			
LTP & Credits	L	T	P	Credits
	3	0	0	3
TotalContactHours	36			
Pre-requisites	None			

Learning Objective:

In this course, students will learn about the representation of numbers in a computer system and how digital circuits can be designed using logic gates and flip-flops. They will also learn about the process of digital-to-analog and analog-to-digital conversions. After completing this course, students will be in a better position to understand the basic operation of a computer system and how various functional blocks can be implemented.

Course Outcome:

CO1: Explain the binary number system and its importance in digital circuit design.

CO2: Classify and analyze various ways of minimizing switching functions.

CO3: Understand the process of designing combinational logic circuits.

CO4: Understand the process of designing sequential logic circuit modules.

CO5: Understand and remember the process of analog-to-digital and digital-to-analog conversion.

Course Content:

Module 1: Number Systems and Binary Codes [5L]

- Introduction to number systems: decimal, binary, octal, hexadecimal.
- Conversion from one number system to another.
- Signed number representation: sign-magnitude, 1's complement, and 2's complement.
- Addition and subtraction of numbers.
- Binary codes: BCD, excess-3 code, gray code.
- Introduction to floating-point representation and its importance in representing real numbers in digital systems.

Module 2: Logic Families and Minimization of Switching Functions [6L]

- Logic gates and their functionalities.
- Logic families: TTL, nMOS, CMOS, pass transistor logic.
- Realization of gates.
- Boolean algebra, truth tables, and switching functions.
- Minimization of completely and incompletely specified switching functions: Karnaugh Map and Quine-McCluskey methods.
- Explanation of buffer and tri-state buffer operations and their applications in digital circuits.
- Introduction to HDL and its importance in describing digital circuits for synthesis and simulation.

Module 3: Combinational Logic Circuits [7L]

- Realization of Boolean functions using NAND/NOR gates.
- Half-adder, full-adder, and ripple-carry adder/subtractor.
- Decoders, Encoders, and Multiplexers: applications in logic design.
- Adder-Subtractor Circuits: Detailed explanation of adder-subtractor circuits and their applications in arithmetic operations.
- Comparator Circuits: Introduction to comparator circuits and their use in comparing binary numbers.

Module 4: Sequential Logic Circuits [7L]

- Clocks, flip-flops, and latches.
- Types of flip-flops: SR, D, JK, T; Edge-triggered and master-slave flip-flops.
- State table and state diagram, state minimization, synthesis of finite state machines (FSMs).

Module 5: Counters and Registers [6L]

- Synchronous and asynchronous counters, up/down counters.
- Applications of counters.
- Registers: parallel-in parallel-out and shift registers, linear feedback shift register (LFSR).
- Applications of registers in datapaths.

Module 6: D/A and A/D Conversion Techniques [5L]

- Digital-to-analog converters: principle of operation, weighted resistor and resistive ladder D/A converters.
- Analog-to-digital converters: resolution and accuracy.
- Types of A/D converters: flash type, counter type, successive-approximation type.
- Sigma-Delta ADCs: Introduction to sigma-delta analog-to-digital converters and their advantages in achieving high resolution.
- Successive Approximation Register (SAR) ADCs: Detailed explanation of successive approximation register ADCs and their operation principles.

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Text/Reference Books:

1. Z. Kohavi and N. K. Jha, "Switching and Finite Automata Theory (3rd Ed.)", Cambridge University Press.
2. M. Morris Mano, "Digital Design (3rd Ed.)", Pearson.
3. G. De Micheli, "Synthesis and Optimization of Digital Circuits", Tata-McGraw-Hill

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS3002				
Course Title	Computer Organization and Architecture				
Category	ENGG, Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	a)Digital Circuits and Logic Design				

Learning Objective:

In this course, students will learn about the evolution of computer systems and development in computer organization and architecture. Special emphasis will be placed on the various functional units of a computer system and how instructions are executed. By the end of the course, students will have a better understanding of how programs are executed in a computer system.

Course Outcomes:

CO1: Explain the process of instruction execution.

CO2: Analyze and design the control unit of a computer system.

CO3: Analyze and design adder, multiplier, and division units.

CO4: Analyze and design memory subsystems.

CO5: Explain and classify various input/output data transfer techniques.

Course Content:

Module 1: Evolution of Computer System

[4L]

- Introduction to computing system
- Computer organization and architecture
- Basic functional units of a computer
- Evolution of computers
- Stored-program concept
- Von Neumann and Harvard models

Module 2: Basic Operation of Computer

[7L]

- Instruction Set Architecture
- CPU registers
- Instruction format and encoding
- Addressing modes
- Instruction set
- Instruction types
- Instruction decoding and execution
- Basic instruction cycle
- Reduced Instruction Set Computer (RISC)
- Complex Instruction Set Computer (CISC)
- Case study: MIPS Instruction set, MIPS assembly language programming
- Pipelining: Basic concepts, pipeline hazards, techniques to overcome hazards (e.g., forwarding, stalling, branch prediction)
- Case study: Pipeline stages and operation in a modern processor (e.g., Intel or AMD processors)

Module 3: Processor Unit Design

[7L]

- Register transfer operations

- Internal single and multi-bus architecture
- Design of control unit: hardwired control unit design, micro programmed control unit design, concept of control word and control store
- Horizontal, vertical, and diagonal micro programmed control unit design

Module 4: Arithmetic Unit Design

[6L]

- Adder and subtractor
- Shift-and-add multiplication
- Signed multiplication: Booth's algorithm, integer division, restoring and non-restoring division
- Floating-point representation: IEEE floating point format, floating-point arithmetic
- Superscalar and out-of-order execution: Concepts and advantages
- Speculative execution: Purpose and implementation in modern processors

Module 5: Memory Unit Design

[7L]

- Basic memory types: Random Access Memory (RAM), Read Only Memory (ROM), Static RAM, Dynamic RAM
- Memory hierarchy
- Cache memory: mapping techniques, memory interleaving
- Virtual memory: Concepts, benefits, implementation (e.g., page tables, TLB)
- Memory management techniques: Fragmentation, compaction, techniques to reduce fragmentation (e.g., buddy system)

Module 6: Input Output Organization

[5L]

- I/O mapped I/O and Memory mapped I/O
- Synchronous and Asynchronous serial data communication
- Secondary memory: disk, flash memory
- I/O Data transfer techniques: Programmed I/O, Interrupt-driven I/O, Direct Memory Access (DMA)

Text/Reference Books:

1. C. Hamacher, Z. Vranesic, and S. Zaky, “Computer Organization (5th Ed.)”, Tata-McGraw-Hill.

2. W. Stallings, “Computer Organization and Architecture (6th Ed.)”, Prentice Hall of India.
3. D. A. Patterson, and J. L. Hennessy, “Computer Organization and Design – The Hardware/Software Interface”, Morgan Kaufmann.

CO-POMapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS3003				
Course Title	Design and Analysis of Algorithms				
Category	ProfessionalCore				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
TotalContactHours	36				

Learning Objective: The course will cover topics such as algorithm complexity concepts and diverse algorithmic designs, including divide and conquer, dynamic programming, and greedy algorithms. It will also include important search and sorting algorithms, graphs, and basic approaches to optimization.

Course Outcome:

1. To understand the concepts of time and space complexity, worst case, average case, and best case complexities, and the big-O notation.
2. To apply design principles and concepts to algorithm design.
3. To understand and analyze the mathematical foundation in the analysis of algorithms.
4. To explain and classify different algorithmic design strategies.
5. To analyze the efficiency of algorithms using time and space complexity theory.

Course Content:

Module 1: Complexity Analysis

[4L]

- Time and space complexity
- Different asymptotic notations and their mathematical significance
- Solving recurrences: substitution method, recurrence tree method, Master Theorem

Module 2 Divide and Conquer**[8L]**

- Basic concept
- Examples: binary search, merge sort, quick sort and their complexity (all three cases)
- Heap sort and its complexity
- Karatsuba algorithm
- Introduction to randomized algorithms and their application in divide and conquer
- Lower Bound Theory: Comparison trees, Oracle and adversary argument, State space method

Module 3: Dynamic Programming**[10L]**

- Basic concepts
- Matrix chain manipulation
- Strassen's algorithm
- Longest common subsequence
- All-pair shortest paths (Floyd Warshall)
- Single-source shortest path (Dijkstra, Bellman-Ford)
- 0/1 Knapsack problem
- Traveling Salesman problem
- Greedy Method: Basic concept
- Examples: fractional Knapsack problem, job sequencing with deadlines
- Minimum cost spanning tree using Prim's and Kruskal's method
- Huffman encoding and decoding
- Advanced dynamic programming techniques (e.g., memoization, tabulation)
- Backtracking: Basic concept
- Examples: n-queens problem, graph coloring problem
- Disjoint Set Manipulation: Set manipulation algorithm like UNION-FIND, union by rank

Module 4: String Matching Problem**[8L]**

- Different techniques: Naive algorithm, string matching using finite automata, and Knuth, Morris, Pratt (KMP) algorithm with their complexities
- Rabin-Karp algorithm for string matching with a rolling hash function
- Boyer-Moore algorithm for string searching with a heuristic to skip comparisons
- Amortized Analysis and Network Flow: Aggregate, Accounting, and Potential Method
- Ford Fulkerson algorithm
- Max-Flow Min-Cut

Module 5: Notion of NP-Completeness**[6L]**

- NP class, NP-hard class, NP-complete class, their interrelationship
- Reductions and Polynomial time Reducibility
- Satisfiability problem (3-SAT and 2-SAT)
- Cook-Levin's theorem
- Clique decision problem
- Vertex Cover problem
- Additional small important topics in existing modules

Text/Reference Books:

1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, "Introduction to Algorithms", MIT Press.
2. E. Horowitz and S. Sahni, "Fundamentals of Computer Algorithms", Universities Press.
3. K. Mehlhorn and P. Sanders, "Data Structures and Algorithms", Springer.
4. A. Aho, J. Hopcroft, and J. Ullman, "Design and Analysis of Computer Algorithms", Addison-Wesley.
5. D.E. Knuth, "The Art of Computer Programming (Vol.3)", Addison-Wesley.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
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Course Code	YCS3004
Course Title	Computational Biology

CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Category	SCI			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None/ If Any			

Learning Objective:

The course is explained the principles of systems biology and the central dogma of molecular biology. Explore various biological databases and understand their structure, including sequence and gene expression data. This course analyze biological sequences through alignment and similarity measures by applying dynamic programming and heuristic algorithms for sequence alignment. Use Hidden Markov Models (HMM) for pair wise alignment and motif discovery

Course Outcome:

CO1: Explain key concepts of cell biology, systems biology, and the central dogma, along with the role of biological databases in bioinformatics.

CO2: Retrieve and interpret biological sequence and expression data from major public databases such as NCBI and assess the challenges of biological data integration.

CO3: Apply sequence alignment techniques including dynamic programming, heuristic methods, and Hidden Markov Models to analyze genetic sequences.

CO4: Construct and evaluate phylogenetic trees and perform motif discovery using computational methods.

CO5: Implement clustering and classification algorithms to analyze biological data, and interpret the results in the context of biological information systems.

Course Content:

Module 1: Cell Biology [10L]

System Biology, Central Dogma, Biological Database: Sequence data, Gene expression data, Micro-array experiment, NCBI database, Challenges faced in the integration of biological data, Data management and data integration in bio-informatics, Issues related to the designing of a biological information system.

Module2: Sequence similarity, homology, and alignment. Pair wise alignment [14L]

Scoring model, dynamic Programming algorithms, heuristic alignment, and pair wise alignment using Hidden Markov models (HMM), multiple alignment: scoring model, local alignment gapped and ungapped global alignment. Motif finding: motif models, finding occurrence of known sites, discovering new sites, Amino Acid, Protein, Phylogenetic tree construction: Neighbor Joining Algorithm.

Module 3: Clustering algorithms: [12]

K-means, k-medoid, Isodata, AGNES, DIANA, BIRCH, DBSCAN, CHAMELON, Grid based methods, Model based methods Classifier: Bayes theorem, Naïve Bayes classifier, Bayesian belief network,

Text /Reference Books:

1. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, New York: Garland Science; 2002
2. Bioinformatics: Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press
3. Bioinformatics And Functional Genomics: A Short Course, Jonathan Pevsner, Wiley-Liss
4. Data Mining Concepts and techniques, Han &Kamber,Elsevier
5. Introduction to Bioinformatics, Arthur M. Lesk, Oxford University Press
6. Developing Bioinformatics Computer Skills,CynthiaGibas, Per Jambeck,O'Reilly
7. An Introduction to Bioinformatics Algorithms,Neil C. Jones, Pavel A. Pevzner,MIT Press (MA).

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

CourseCode	YCS3101			
CourseTitle	Digital Logic and Electronics Laboratory			
Category	ProfessionalCore			
LTP&Credits	L	T	P	Credits
	0	0	3	1.5
TotalContactHours	36			
Pre-requisites	None			

Learning Objective:

In this laboratory course, students will conduct hands-on sessions for the design and implementation of combinational and sequential digital circuit modules, as well as interfacing LED and 7-segment display units.

Course Outcome:

- CO1: To understand and test the functionalities of basic gates.
 CO2: To understand Boolean functions using various combinational circuit modules (like gates, multiplexer, decoder, etc.).
 CO3: To understand and verify the functions of flip-flops and other sequential circuit elements (like counter, register, etc.).
 CO4: To understand and analyze complex digital systems and verify the functionality.
 CO5: To design a data path consisting of an ALU, registers, and multiplexers, and then design the control path to compute the Greatest Common Divisor (GCD) of two numbers.

Course Content:

1. Design a basic inverter using transistors, obtain the transfer characteristics, and measure the propagation delay. Repeat the experiment using an inverter chip.
2. Given a Boolean function, minimize it and realize the function using NAND gates. Using a 555 timer, design a rectangular waveform generator of a given frequency.
3. Design a full-adder using basic gates. Cascade two such full-adders to realize a 2-bit adder. Connect LEDs to observe the outputs and verify the functionality.
4. Verify the functionality of multiplexer and decoder chips. Implement a 4-variable Boolean function using an 8-to-1 multiplexer.
5. Implement RS and JK master-slave flip-flops using NAND gates and verify their functionalities. Verify the functionality of a J-K flip-flop chip.
6. Using JK or D flip-flops, design a 4-bit shift register and verify the functionality. Modify the designs to make it into (a) a ring counter, (b) Johnson counter and verify the functionality.
7. Design a 3-bit synchronous counter that counts in some arbitrary count sequence. Apply a square wave at the clock input and analyze the waveforms observed.
8. Design a 2-digit BCD counter and display the count value on 7-segment display units.
9. Design an 8-bit modulo-N counter for some arbitrary value of N. Connect a D/A converter at the output of the counter and observe the output waveform. Analyze the operation for various values of N. Use the circuit to display the transfer characteristic of a NOT gate on the oscilloscope.
10. Design a data path consisting of an ALU, registers, and multiplexers. Hence design the control path to compute the GCD of two numbers.

Text/Reference Books:

1. Z. Kohavi and N. K. Jha, "Switching and Finite Automata Theory (3rd Ed.)", Cambridge University Press.
2. M. Morris Mano, "Digital Design (3rd Ed.)".
3. G. De Micheli, "Synthesis and Optimization of Digital Circuits", Tata-McGraw-Hill.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

CourseCode	YCS3104			
CourseTitle	IT Workshop Lab(SciLab/MATLAB/C++)			
Category	ENGG, Skill Enhancement Course			
LTP&Credits	L	T	P	Credits
	0	0	3	3
TotalContactHours	36			

Pre-requisites	None
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Learning Objective:

The purpose of this course is to learn and practice basic programming concepts, skills needed for basic problem solving, and applications—plots and built-in statistical and set operations, all using MATLAB as the vehicle. MATLAB is a powerful software package that has built-in functions to accomplish a diverse range of tasks, from mathematical operations to three-dimensional imaging. Additionally, MATLAB has a complete set of programming constructs that allow users to customize programs to their own specifications.

Course Outcome:

CO1: To impart knowledge to the students using MATLAB software that enhances programming knowledge in Research and Development.

CO2: To introduce the MATLAB technical computing environment for the analysis and visualization of data to understand and predict future scenarios.

CO3: To introduce students to the use of a high-level programming language, MATLAB, for solving scientific and engineering problems.

CO4: Reinforce a structured, top-down approach to formulate and solve problems.

CO5: Introduce common approaches, structures, and conventions for creating and evaluating computer programs, primarily in a procedural paradigm.

Course Content:

1. Basic Commands:

- Clear Command: Removes all variables from the workspace.
- Clc Command: Clears the command window and homes the cursor.
- Help Command: Displays help about a topic if it exists.
- Lookfor Command: Provides help by searching through all the first lines of MATLAB help topics and returning those that contain a keyword you specify.
- Edit Command: Enables you to edit (open) any M-file in the Editor Window. This command does not open built-in functions like sqrt. See also the type Command.
- More command: More on enables paging of the output in the MATLAB command window, and more off disables paging of the output in the MATLAB command window.

2. Create/Initialize Matrix:

- Separate the elements of a row with blanks or commas, use semicolons to indicate the end of each row, and surround the entire list of elements with square brackets.

3. Matrix Operations:

- Display the result of addition, subtraction, and multiplication operations on matrices.

4. Colon Operator:

- Create and display vectors using the colon operator along with spacing, perform possible arithmetic operations, and validate the result.

5. Zero and Unit Matrix:

- Create and display zero and unit matrices of the required size.

6. Matrix Manipulations:

- Find and display the inverse and transpose of a given matrix, find the largest element in each vector of the matrix, and store it at n+1 positions of each row or vector. Also, find the maximum element of the matrix at n+1, m+1 positions, where n and m are the sizes of the given matrix.

7. Display Results of Various Commands/Functions:

- Diag(), prod(), median(), sort(), det(), tril(), and triu().

8. Built-in Functions:

- Write a program to display the result of various built-in functions like abs(), atan(), ceil(), log(), rem(), sqrt(), rand(), randn(), and mod().

9. Plotting:

- Plot a graph of y versus x, where x values range from zero to 2π , and y values are the sine of x.

10. Graph Labeling:

- Display the graph with proper labeling using xlabel, ylabel, and title commands.

11. Plotting Sinc Function:

- Plot the Sinc function, where $\text{Sinc}(x) = \sin(x) / x$, and $-2\pi \leq x \leq 2\pi$.

12. M-File Program:

- Write a program in an M-File to read a 3x3 Matrix, then display the diagonal of the matrix.

13. String Manipulation:

- Write a program to read a string, then replace each character in the string with its following character in ASCII code.

14. Control Structures:

- Programs using control structure statements. For example, display all prime numbers between two given input values.

15. Image Processing:

- Write a program to read an image and display the resulting image of the following commands: imresize() and imhist().

Text/Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing MATLAB, Pearson Education Inc., 2004.
2. Stormy Attaway, MATLAB: A Practical Introduction to Programming and Problem Solving, Butterworth-Heinemann Publisher, 2013.
3. [MathWorks Book by Cleve Moler](#)
4. [MATLAB Getting Started Guide](#)

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS3102			
Course Title	Computer Organization and Architecture Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a)Digital Circuits Laboratory			

Learning Objective:

In this laboratory course, students will conduct experiments using a MIPS instruction set simulator. They will also learn how to model various hardware blocks using the hardware description language Verilog. They shall be designing various functional units like adder, multiplier, processor, etc., using Verilog.

Course Outcome:

1. CO1: To understand how to write assembly language programs in MIPS.
2. CO2: To design various combinational and sequential circuits using Verilog.
3. CO3: To design and analyze various CPU functional units using Verilog.
4. CO4: To apply a pipelined processor using Verilog.
5. CO5: To implement and simulate the MIPS 5-stage pipeline in Verilog, utilizing a subset of 16 instructions, and validate the design by composing a comprehensive test bench with sample machine language programs stored in a memory module.

Course Content:

1. Familiarization with MIPS assembly language programming using an instruction set simulator like QtSPIM.
 - Reading and displaying an arbitrary string and an integer.
 - Storing numbers sequentially in memory and finding the minimum, maximum, and sum.
 - Sorting a set of numbers stored in memory. [2 days]
2. Familiarization of function calls with MIPS assembly language programming.
 - Writing a function to compute the factorial of a given number.
 - Writing a function to compute the GCD of two numbers.
 - Writing a function to compute the N-th Fibonacci number. [2 days]
3. Familiarization with a Verilog simulator like iVerilog and writing simple combinational and sequential modules using behavioral and structural modeling with Verilog.
 - Writing a module to implement an arbitrary Boolean function (e.g., $F=A'BC+C'D$).
 - Writing a module to implement a full adder and hence a 4-bit ripple carry adder.
 - Writing a module to implement a D flip-flop and hence a 4-bit shift register.
 - Writing a module to implement an 8-bit up-down counter with asynchronous clear. [2 days]
4. Writing Verilog modules to implement functional blocks used in computer organization.
 - Writing a module to implement a 16-bit arithmetic and logic unit with 8 functions.
 - Writing a module to implement read/write operations in a 1024x16 memory system. [2 days]
5. Implementing the MIPS 5-stage pipeline in Verilog, using a subset of 16 instructions. The design has to be tested by writing a test bench containing sample machine language programs stored in a memory module. [4 days]

Text/Reference Books:

1. qtSPIM simulator, <http://spimsimulator.sourceforge.net/>
2. MIPS overview, <https://tams.informatik.uni-hamburg.de/applets/hades/webdemos/mips.html>
3. M. M. Mano and M. D. Ciletti, "Digital Design: with an Introduction to Verilog HDL (5th Ed.)", Pearson Education.
4. J. Bhasker, "Verilog HDL Synthesis: A Practical Primer", B.S. Publications.

CO-PO Mapping:

Course Outcome (CO)	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	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

CourseCode	YCS3103				
CourseTitle	Design and Analysis of Algorithms Laboratory				
Category	ProfessionalCore				
LTP&Credits	L	T	P	Credits	
	0	0	3	1.5	
TotalContactHours	36				
Pre-requisites	a)ProgrammingPractices I				

Learning Objective:

The course aims to provide strategies (divide and conquer, dynamic programming, greedy method) to solve problems in computer science effectively. Using these paradigms, the course will demonstrate innovative and effective approaches to solving specific problems. Rigorous proof of algorithm validity will be emphasized.

Course Outcome:

CO1: To prove the correctness and analyze the running time of basic algorithms.

CO2: To design algorithms using dynamic programming, greedy method, backtracking, branch and bound strategy, and to describe algorithms that employ these strategies.

CO3: To compare, contrast, and choose appropriate algorithmic design techniques to present an algorithm that solves a given problem.

CO4: To identify and analyze criteria and specifications appropriate to new problems.

CO5: To apply algorithmic design techniques to solve real-world scheduling and routing problems, demonstrating proficiency in graph coloring, backtracking, and optimization approaches.

Course Content:

1. Experiments on Divide and Conquer Approach:

- Binary Search (Recursive & Iterative)
- Merge Sort, Heap Sort, Quick Sort
- Find Maximum and Minimum element from an array of integers Duration: 2 days

2. Experiments on Dynamic Programming:

- Minimum number of scalar multiplications needed for chain of matrix
- All pair of shortest paths for a graph
- Single-source shortest path for a graph (Dijkstra, Bellman-Ford)
- Longest common subsequence problem Duration: 2 days

3. Experiments on Backtracking:

- The n-Queens problem
- Graph Coloring problem Duration: 2 days

4. Experiments on Greedy Methods:

- Knapsack problem
- Job sequencing with deadlines
- Minimum cost spanning tree by Prim's and Kruskal's algorithm Duration: 2 days

5. Innovative Experiments:

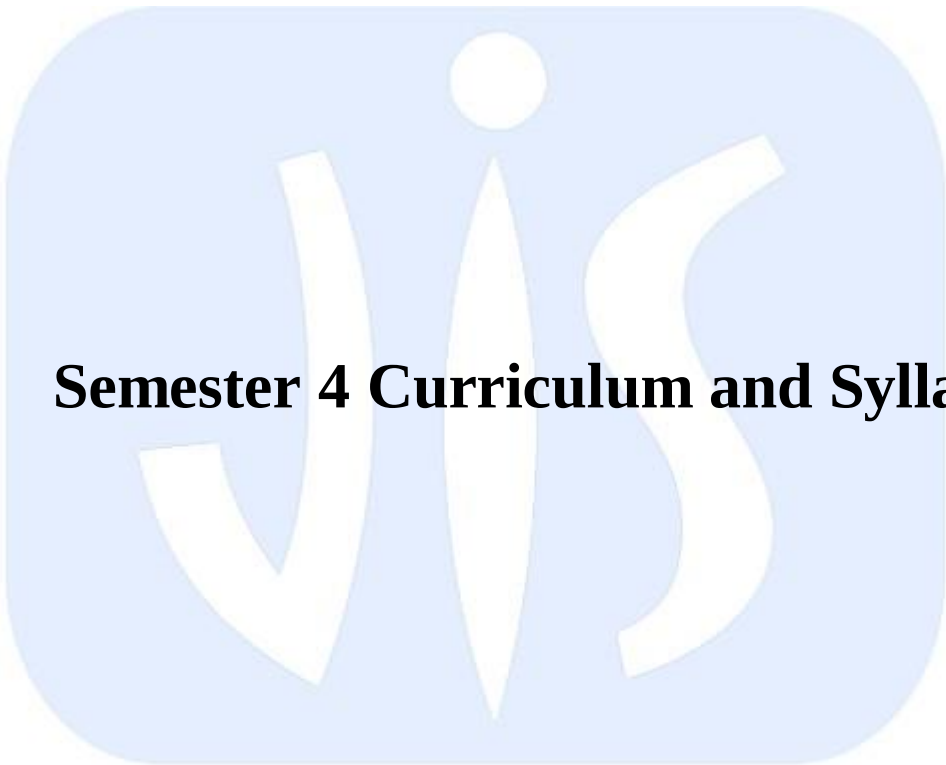
- Take the university timetable for all departments. Write a computer program to find all conflicts within the timetable using graph coloring approach. Provide a solution using Backtracking. Compute the distance and find the stoppages every classmate of yours cover to reach the institute. Then assume their speeds based on their travelling modes. Compute each student's minimum time to reach the institute premises. Duration: 2 days

Text/Reference Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to Algorithms", MIT Press.
2. E. Horowitz and S. Shani, "Fundamentals of Computer Algorithms", Universities Press.
3. K. Mehlhorn and P. Sanders, "Data Structures and Algorithms", Springer.

CO-POMapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Semester 4 Curriculum and Syllabus

UNIVERSITY

Course Code	YCS4005			
Course Title	Discrete Mathematics			
Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, the students will learn about the mathematical foundations of computer science. The specific topics that would be covered include propositional calculus and proof techniques, set theory and other derived algebraic structures, recurrence relations, and the theory of graphs. The course will be very helpful for the students as it acts as a prerequisite for various next-level courses like algorithms, automata theory, artificial intelligence, etc.

Course Outcome:

- CO1: To explain the distinctive characteristics of propositional logic and its applications.
 CO2: To demonstrate the applications of various proof techniques.
 CO3: To explain the basic concepts of sets, relations, functions, and various algebraic structures.
 CO4: To understand the concept of recurrence relations and methods of solution.
 CO5: To explain and analyze the concept of graphs and various graph algorithms.

Course Content:

Module 1: Propositional Logic

[6L]

- Introduction to Propositional Calculus: Propositions, Logical Connectives, Conjunction, Disjunction, Negation.
- Conditional Connectives, Implication, Converse, Contrapositive, Inverse, Bi-conditional statements, Logical Equivalence, Tautology.
- Conjunctive and disjunctive normal forms.
- Universal and existential quantifiers and their negations.

Module 2: Proof Techniques

[6L]

- Forward proof, proof by contradiction, contrapositive proofs, proof by mathematical induction, proof of necessity and sufficiency.
- Weak Induction and Strong Induction.

Module 3: Sets, Relations and Functions

[8L]

- Operations on sets, relations and functions, binary relations, partial ordering relations, equivalence relations.
- Finite and infinite set, countable and uncountable sets.
- Algebraic structures with one binary operation: semigroups, monoids, and groups.
- Algebraic structures with two binary operations: rings and fields.
- Power Sets, Cardinality of Finite and Infinite Sets.

Module 4: Recurrence Relations

[6L]

- Recurrence relations: Formulation of different counting problems in terms of recurrence relations.

- Solution of recurrence relations with constant coefficients by (i) iterative method, (ii) characteristic roots method, (iii) generating functions method.
- Pigeonhole principle.

Module 5: Introduction to Graphs

[10L]

- Graphs and their basic properties: digraphs, weighted graph, connected and disconnected graph, bipartite graph, complement of a graph, regular graph, complete graph, walk, path, circuit, Euler graph, cutset, cutvertices, adjacency and incidence matrices of a graph, isomorphism.
- Graph coloring problem, planar graphs, trees.
- Hamiltonian Graphs, Dijkstra's Algorithm.

Text/Reference Books:

1. C.L. Liu, "Elements of Discrete Mathematics", Tata McGraw-Hill.
2. J-P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", McGraw-Hill Education.
3. S.K. Chakraborty and B.K. Sarkar, "Discrete Mathematics", Oxford University Press.
4. R. Graham, D.E. Knuth, and O. Patashnik, "Concrete Mathematics: A Foundation for Computer Science", Addison-Wesley.
5. N. Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4001			
Course Title	Operating Systems			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Data Structures and Algorithms Computer Organization and Architecture			

Learning Objective:

In this course, students will learn about the role of an operating system as the interface between application programs and computer hardware. They will understand how the operating system manages various computer resources, which is essential for handling large software projects effectively.

Course Outcomes:

CO1: To explain the role of an operating system and how it acts as an interface between hardware and software.

CO2: To contrast the concepts of processes and threads, and how they are scheduled.

CO3: To demonstrate the use of various synchronization tools in solving the critical section problem.

CO4: To explain and classify various memory management techniques, including virtual memory.

CO5: To apply the knowledge of data structures to explain how file systems can be implemented on secondary storage.

Course Content:

Module 1: Introduction to Operating Systems [4L]

- Functionalities of an operating system – hardware/software interface.
- Evolution of operating systems – batch, multi-programmed, time-sharing, real-time, distributed.
- Simultaneous Peripheral Operations On-Line (SPOOL).
- Protection and Security – user/supervisory mode, privileged instructions, system calls (invoking OS services).

Module 2: Processes and Threads [7L]

- Processes – basic concept, process control block (PCB), process state transition diagram.
- Process scheduling – independent and cooperating processes, inter-process communication using shared memory and message passing. Case studies from Unix/Linux.
- Threads – lightweight process concept, benefits of threads, user and kernel-level threads, using thread library in Unix/Linux.
- CPU Scheduling – scheduling criteria, preemptive and non-preemptive scheduling. Scheduling algorithms – FCFS, SJF, SRTF, RR, priority, multi-level feedback queue.

Module 3: Process Synchronization and Deadlocks [7L]

- Classical problems of process synchronization – producer-consumer, reader-writer, dining philosopher, etc.
- Critical section problem – illustration, software solutions, solution using synchronization hardware: test-and-set (TST) and SWAP instructions.
- Semaphores – definition, binary and counting semaphores, implementation of semaphores, minimizing busy waiting. Case studies from Unix/Linux.
- Deadlocks – deadlock characterization, methods of handling deadlock, deadlock prevention versus deadlock avoidance, Banker's algorithm.

Module 4: Memory Management [8L]

- Logical versus physical address space, swapping, contiguous memory allocation, memory protection using fence registers.
- Paging – basic concept, performance analysis, translation look-aside buffer (TLB). Segmentation.
- Virtual memory – separation of logical and physical address space, demand paging, locality of reference. Page replacement algorithms – FCFS, LRU, Optimal, Belady's anomaly. Thrashing, working set model.
- Page table structure and its optimization techniques. Segmentation with paging (combined scheme). Memory protection and access control mechanisms. Shared memory and memory-mapped files.
- Case studies on memory management in modern operating systems (e.g., Windows, macOS, Linux).

Module 5: Device and File Management [7L]

- Disk structure – cylinders, tracks, and sectors.
- Disk scheduling algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK.
- File system – file concept, access methods, directory and file system structure, allocation methods (contiguous, linked, indexed), free space management. Case study for Unix/Linux.
- Disk management optimizations (e.g., track skewing, clustering, buffering), RAID levels and their implications for performance and fault tolerance.
- File system reliability and recovery mechanisms (e.g., journaling, shadowing), Network file systems and distributed file systems (e.g., NFS, AFS, CIFS).
- Case studies on file systems used in cloud computing and distributed systems.

Module 6: Miscellaneous Topics

[3L]

- Brief overview of real-time and distributed operating systems, mobile operating systems.

Text/Reference Books:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, “Operating System Concepts”, Wiley Asia.
2. D. M. Dhamdhere, “Operating Systems: A Concept-Based Approach”, Tata McGraw-Hill.
3. M. Bach, “Design of the Unix Operating System”, Prentice-Hall of India.
4. W. Stallings, “Operating Systems: Internals and Design Principles”, Prentice-Hall of India.
5. C. Crowley, “Operating System: A Design-Oriented Approach”, Irwin Publishing.
6. G. J. Nutt, “Operating Systems: A Modern Perspective”, Addison-Wesley.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4002			
Course Title	Formal Language and Automata Theory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Discrete Mathematics b) Programming and Data Structure			

Learning Objective:

In this course, students will learn the theory of computation, including formal language classes and their relationships, techniques to prove or disprove theorems in automata theory using its properties, and approaches to determine the decidability and intractability of computational problems. At the end of the course, students will be able to analyze complex problems and automata to find solutions.

Course Outcome:

CO1: Explain the basic properties of formal languages and grammars.

CO2: Understand the tools for recognizing different formal languages.

CO3: Differentiate between regular, context-free, and recursively enumerable languages.

CO4: Apply the theory of computation and computational models, including decidability and intractability.

CO5: Analyze complex problems and automata to find solutions using the theory of computation and computational models, including decidability and intractability.

Course Content:

Module 1: Introduction to Finite Automata

[10L]

- Finite Automata, Alphabets, Strings, Languages
- Regular Languages, Deterministic Finite Automata (DFA)
- Nondeterministic Finite Automata (NFA)
- Equivalence of NFA and DFA
- Minimization of Finite Automata
- Myhill-Nerode Theorem
- FA with output: Moore and Mealy machine

Module 2: Properties of Regular Expression

[7L]

- Operators of regular expression and their precedence
- Algebraic laws for Regular expressions
- Kleen's Theorem
- Regular expression to FA
- Non-Regular Languages

- Pumping Lemma for regular Languages

Module 3: Language & Grammar Formalism

[9L]

- Grammars, Regular grammars
- Context-Free Grammar
- Derivation, Derivation trees
- Ambiguity in Grammar
- Simplification of CFGs
- Normal forms for CFGs - CNF and GNF

Module 4: Push Down Automata

[4L]

- PDA Description and definition
- Acceptance by Final state, Acceptance by empty stack
- Deterministic PDA
- Equivalence of PDA and CFG

Module 5: Turing Machines and Decidability

[6L]

- Basic model, Definition and representation
- Language acceptance by TM
- Church's Thesis
- Recursive and recursively enumerable languages
- Halting problem
- Introduction to Undecidability

Text/Reference Books:

1. J. D. Ullman, J. Hopcroft and R. Motwani, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 2007
2. P. Linz, "An Introduction to Formal Languages and Automata", Jones & Bartlett Learning, 2012
3. K. L. P. Mishra and N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", Prentice Hall India, 2008
4. M. Sipser, "Introduction to Theory of Computation", Thomson Course Technology, 2006

5. J. C. Martin, "Introduction to Languages and Theory of Computations", McGraw Hill, 2011
6. E. A. Rich, Automata, "Computability and Complexity", Pearson Education, Inc., 2019
7. D. Kozen, "Automata and Computability", Springer, 1997
8. H. R. Lewis and C. H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall of India Private Ltd., 1998
9. Z. Kohavi and N. K. Jha, "Switching and Finite Automata Theory", Cambridge University Press, 2010
10. D. I. A. Cohen, "Introduction to Computer Theory", John Wiley & Sons, Inc., 1986

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4003			
Course Title	Object Oriented Programming using Java			
Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Fundamentals of Programming b) Object Oriented Programming			

Learning Objective:

The course aims to provide a comprehensive understanding of Java programming with a focus on object-oriented concepts. Students will learn the fundamentals of Java, including data types, variables, control statements, and arrays. They will also gain knowledge of OOP principles such as encapsulation, inheritance, polymorphism, and abstraction. Additionally, the course covers advanced topics like exception handling, multithreading, and GUI programming in Java.

Course Outcome:

CO1: Explain the process of interaction between objects, classes, and methods.

CO2: Acquire a basic knowledge of Object Orientation with different properties.

CO3: Analyze various string handling functions with various I/O operations.

CO4: Discuss basic code reusability features with respect to Inheritance, package, and Interface.

CO5: Implement Exception handling, Multithreading, and Applet (Web program in Java) programming concepts in Java.

Course Content:

Module 1: Java Basics

[8L]

- JVM architecture
- Data types, variables, and operators
- Control statements
- Arrays
- Exception handling
- Java Collections Framework (List, Set, Map, Array List, Linked List, Hash Set, Hash Map)

Module 2: Object-Oriented Programming

[7L]

- Encapsulation
- Class fundamentals
- Object & Object reference
- Constructors
- Access control
- Nested methods
- Abstract Class & Interfaces
- Enumerations
- Packages
- Reflection

Module 3: Inheritance and Polymorphism

[9L]

- Types of inheritance
- Member access rules

- Usage of this and Super keyword
- Method Overloading and Overriding
- Abstract classes
- Dynamic method dispatch
- Packages and Interfaces
- I/O Streams

Module 4: Exception Handling and Multithreading

[6L]

- Exception types
- Try, Catch, Throw, Throws, Finally
- Thread basics
- Thread Life-Cycle
- Synchronizing Threads
- Inter Communication of Threads
- Critical Factor in Thread
- Deadlock

Module 5: GUI Programming and Applet

[6L]

- Applet vs. Application
- Applet Lifecycle
- GUI Programming basics
- AWT Components
- Swing Components
- Java Utilities (java.util Package)

Text/Reference Books:

1. "Java: The Complete Reference" by H. Schildt and C. Dann
2. "Programming With Java: A Primer" by E. Balagurusamy
3. "Thinking in JAVA" by B. Eckel
4. "Database Programming with JDBC and JAVA" by G. Reese

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

CourseCode	YBB4001				
CourseTitle	Principles of Management				
Category	HUM, Ability Enhancement Course				
LTP&Credits	L	T	P	Credits	
	2	0	0	2	
TotalContactHours	24				
Pre-requisites	None				

Learning Objective:

In this course, students will learn about the fundamental principles of management used in the industry and different organizations. They will study various fields of management and related theories, applying them practically to enhance their management skills. By the end of the course, students will understand and interpret the knowledge and skills necessary to work as effective managers.

Course Outcomes:

CO1: To familiarize students with the origins of management principles and compare them with modern trends in management theories.

CO2: To understand the essential functions of management along with theories framed by management experts in the business field.

CO3: To explain the managerial process and related functions that facilitate change.

CO4: To understand the relationship between various levels of management in a business organization and the process of achieving objectives.

CO5: To explain the importance of feedback control in the management process, along with relevant theories, and to apply proper management principles in modern business practices to solve problems.

Course Content:

Module 1: Management

[4L]

- Definition, Nature, Importance, and Evolution of Management
- Contributions of Fayol, Taylor, Hawthorne, Maslow

- Management as an Art or Science?
- Functions of a Manager (Duties and Responsibilities)
- Ethics in Management

Module 2: Planning and Control [4L]

- Planning (Steps, Types, and Barriers)
- McKinsey Approach, SWOT Analysis
- Operational and Strategic Planning
- Controlling (Concept, Relationship with Planning, Process, Dimensions)
- Management by Objectives (MBO)

Module 3: Decision Making and Organizing [4L]

- Decision Making Process
- Certainty and Uncertainty in Decisions
- Brainstorming
- Process of Organizing
- Authority and Responsibility
- Delegation and Empowerment
- Centralization and Decentralization
- Departmentation

Module 4: Staffing [4L]

- Manpower Planning
- Job Design
- Selection and Recruitment
- Training and Development
- Performance Appraisal

Module 5: Leadership and Communication [3L]

- Role of Leadership
- Theories of Leadership
- Qualities of a Good Leader
- Development of Leadership
- Communication Process and Types
- Electronic Media

Module 6: Group Dynamics [2L]

- Group Concept
- Stages of Group Formation
- Types of Groups

Module 7: Recent Trends in Management

[3L]

- Social Responsibility in Management
- Changes in Management
- Total Quality Management (TQM)
- Stress Management
- International and Global Management
- Crisis Management

Text/Reference Books:

1. H. Cortes, D. S. Bright, and E. Hartman, "Principles of Management".
2. R. B. Rudani, "Principles of Management".
3. M. Gupta, "Principles of Management".
4. L. M. Prasad, "Principles and Practice of Management".

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4101			
Course Title	Operating Systems Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Data Structures and Algorithms Computer Organization and Architecture			

Learning Objective:

In this laboratory course, students will carry out various software assignments on Unix/Linux shell programming and system calls. Additionally, assignments for simulating important OS modules like CPU scheduling, file system, etc., shall be carried out.

Course Outcome:

- CO1: To learn how to write shell scripts.
 CO2: To learn how to use Unix/Linux system calls and to design a shell program.
 CO3: To analyze the performance of CPU scheduling algorithms through simulation.
 CO4: To learn how to use multi-threaded programming.
 CO5: To design and implement one OS module like memory management, file system, etc.

Course Content:

Suggestive List of Experiments:

1. Write shell scripts using "bash" shell scripting language for simple system administration tasks, text search and replacement, directory and file manipulation, simple numeric computations, etc.
2. Write programs in C for familiarization with the Unix/Linux system calls fork, exec, wait, exit, dup, pipe, shared memory, etc.
3. Write a command-line interpreter (shell) program using the Unix/Linux system calls with the facilities for: (a) running executable programs, (b) running a program in the background, (c) input and output redirection, (d) command piping.
4. Implementation of various CPU scheduling algorithms in C and compare their performances.
5. Write programs using the "pthread" library with multiple threads and use semaphores for mutual exclusion.
6. Design and implement a Unix-like memory-resident file system using the concept of inodes.
 OR Implementation of memory management system supporting virtual memory, and analyze the performance.

Text/Reference Books:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, "Operating System Concepts," Wiley Asia.
2. D. M. Dhamdhere, "Operating Systems: A Concept-Based Approach," Tata McGraw-Hill.
3. M. Bach, "Design of the Unix Operating System," Prentice-Hall of India.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4102
Course Title	Numerical Methods Laboratory

Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	C programming			

Learning Objective:

- To provide an overview of numerical techniques applicable to engineering problems.
- To offer insight into the implementation of these techniques.
- To build confidence in tackling numerical solutions.
- To understand the underlying physics behind numerical methods.
- To aid in method selection by understanding how methods work and their limitations.

Course Outcomes:

- CO1: Demonstrate proficiency in using computer programming tools for engineering calculations.
- CO2: Construct simple computer algorithms using a programming tool.
- CO3: Apply simple numerical methods to solve engineering-related mathematical problems.
- CO4: Appreciate the limitations and applicability of numerical methods.
- CO5: Utilize computer-based numerical methods for solving engineering problems.

Course Content:

Module 1: Solution for Systems of Non-linear Equations

- Roots of non-linear equations using Bisection Method.
- Roots of non-linear equations using Regula Falsi or False Position Method.
- Roots of non-linear equations using Newton-Raphson Method.

Module 2: Solution for Systems of Linear Algebraic Equations

- System of linear equations using Gauss-Elimination Method.
- System of linear equations using Gauss-Seidal Iteration Method.
- System of linear equations using Gauss-Jordan Method.

Module 3: Numerical Integration

- Numerical integration using Trapezoidal Rule.
- Numerical integration using Simpson's Rules.

Module 4: Solution of Interpolation Polynomial

- Solution using Newton Forward Difference Interpolation Polynomial Function.
- Solution using Newton Backward Difference Interpolation Polynomial Function.
- Solution using Lagrange's Interpolation Polynomial Function.

Module 5: Numerical Solution of Ordinary Differential Equations

- Numerical solution of ordinary differential equations by Euler's Method.
- Numerical solution of ordinary differential equations by Runge-Kutta Method of 4th Order.
- Numerical solution of ordinary differential equations by Taylor Series Method.

Text/Reference Books:

1. "Introductory Methods of Numerical Analysis" by S.S. Sastry.
2. "Numerical Methods for Scientific and Engineering Computation" by Mahinder Kumar Jain.
3. "Numerical Methods for Engineers" by Steven C. Chapra and Raymond P. Canale.
4. "Numerical Recipes: Art of Scientific Computing" by W.H. Press, B.P. Flannery, et al.
5. "Numerical Methods" by E. Balagurusamy.

6. "Numerical Methods using MATLAB" by J. M. Mathews and K. Fink.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4103			
Course Title	Object Oriented Programming using Java Laboratory			
Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a) Programming Practices I			

Learning Objective:

The learning objective of this course is to provide students with practical experience in implementing object-oriented programming concepts using Java. Through hands-on exercises and projects, students will learn to design and develop Java applications using classes, inheritance, interfaces, packages, exception handling, file handling, multithreading, and event-driven programming. The course aims to enhance students' understanding and proficiency in Java programming, enabling them to solve real-world problems using object-oriented principles.

Course Outcome:

CO1: Implement and demonstrate an understanding of basic object-oriented programming principles such as classes, objects, inheritance, and polymorphism in Java.

CO2: Design and develop Java applications using interfaces, packages, exception handling, and file handling to solve programming problems.

CO3: Develop multithreaded Java applications to achieve concurrent execution of tasks and improve program efficiency.

CO4: Apply event-driven programming concepts in Java to create interactive graphical user interfaces (GUIs) for applications.

CO5: Work on a mini project that integrates various Java programming concepts learned throughout the course to solve a real-world problem.

Course Content:

1. Electricity Bill Generation using Classes [1 day]

2. Currency Converter, Distance Converter, and Time Converter Implementation using Packages [1 day]
3. Pay Slip Generation using Inheritance [1 day]
4. Stack ADT Implementation using Multiple Inheritance (Interface) [1 day]
5. String Operations using ArrayList [1 day]
6. Abstract Class Implementation [1 day]
7. User-Defined Exception Handling Implementation [1 day]
8. File Handling [1 day]
9. Multithreading Implementation [1 day]
10. Generic Function Implementation [1 day]
11. Calculator Design Using Event-Driven Programming [1 day]
12. Mini Project [1 day]

Text/Reference Books:

1. H. Schildt and C. Dann, "Java: The Complete Reference", McGraw-Hill Education.
2. E. Balagurusamy, "Programming With Java: A Primer", Tata McGraw-Hill.
3. B. Eckel, "Thinking in JAVA", Prentice Hall.
4. G. Reese, "Database Programming with JDBC and JAVA", O'Reilly Media, Inc.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS4104			
Course Title	Programming Using Python Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Fundamentals of Programming Basic Problem Solving			

Learning Objective:

In this practical course, students will learn Python programming basics and paradigms, including

looping, control statements, and string manipulations. They will become familiar with various modules, packages, and Python libraries used for various applications, such as machine learning and deep learning.

Course Outcome:

CO1: Understand and explain the basic principles of Python programming language and object-oriented concepts.

CO2: Define and demonstrate the use of built-in data structures along with the help of condition checking and looping structures.

CO3: Understand and apply various applications of different modules and packages in Python.

CO4: Learn to handle exceptions and files in Python.

CO5: Apply Python programming concepts to develop a computer game for teaching data structures like stacks and queues, enhancing visualization and understanding of abstract concepts through game-based learning.

Course Content:

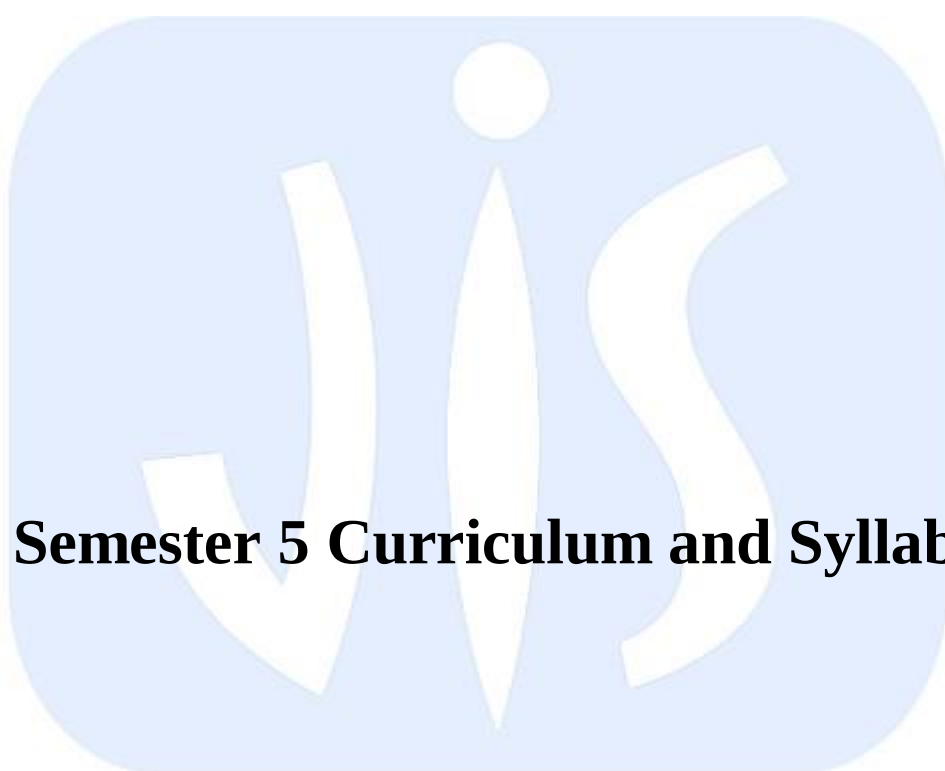
1. History, Features, setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator. [1 day]
2. Conditional Statements: If, If-else, Nested if-else, Looping, For, While, Nested loops, Control Statements: Break, Continue, Pass. [1 day]
3. String Manipulation: Accessing Strings, Basic Operations, String slices, Function and Methods. Lists: Introduction, accessing list, Operations, Working with lists, Function and Methods. [2 days]
4. Tuple: Introduction, accessing tuples, Operations, Working, Functions, and Methods. Dictionaries: Introduction, accessing values in dictionaries, Working with dictionaries, Properties. [2 days]
5. Functions: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. [1 day]
6. Modules: Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, reading data from the keyboard, Opening and closing file, Reading and writing files, Functions. [2 days]
7. Exception and File Handling: Exception, Exception Handling, except clause, Try & finally clause, User-Defined Exceptions. [1 day]
8. Case study on using a computer game for teaching data structures on stacks and queues. The computer game is developed to help students visualize the data structures and data access operations on stacks and queues. This game-based learning is engaging, fun, and, more importantly, abstract concepts in data structures can be visualized and learned through game-playing. [2 days]

Text/Reference Books:

1. T.R. Padmanabhan, "Programming with Python (1st Ed.)", Springer.
2. R. Thareja, "Python Programming: using Problem Solving Approach (1st Ed.)", Oxford University Press.
3. W. McKinney, "Python Data Analysis (2nd Ed.)", O'Reilly.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Semester 5 Curriculum and Syllabus

UNIVERSITY

Course Code	YCS 5001			
Course Title	Artificial Intelligence			
Category	ENGG, Major			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Design and Analysis of Algorithms			

Learning Objective:

In this course, students will learn the basic concepts, theories, and techniques of artificial intelligence, enabling them to understand and apply AI algorithms in various fields of Computer Engineering.

Course Outcome:

CO1: Explain the basic concept of Artificial Intelligence and its applications.

CO2: Classify and analyze various AI tools and techniques.

CO3: Learn and evaluate various AI algorithms.

CO4: Apply the basic understanding of artificial intelligence in real-world applications.

CO5: Evaluate and assess the performance, effectiveness, and ethical implications of artificial intelligence systems in various real-world applications.

Course Content:

Course Content:

Module 1: Introduction to Artificial Intelligence (AI) [7L]

Overview: Foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents.

Module 2: AI Techniques [7L]

Artificial Intelligence programming techniques, Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A*, AO*, min-max, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Module 3: Planning and Representation in AI [8L]

Planning: planning as search, partial order planning, construction and use of planning graphs. Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

Module 4: Decision Making [8L]

Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

Module 5: Knowledge Acquisition

[6L]

Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. Learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Text/Reference Books:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach," Prentice Hall.
2. N. J. Nilsson, "Artificial Intelligence: A New Synthesis," Morgan-Kaufmann, 1998.
3. J. Pearl, "Heuristics: Intelligent Search Strategies for Computer Problem Solving," Addison-Wesley Publishing Company.
4. B. A. Heule, M. Van Maaren, and H. Walsh, "The Handbook of Satisfiability," IOS Press.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5002			
Course Title	Database Management System			
Category	ENGG, Major			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Data Structures and Algorithms			

Learning Objective:

In this course, students will learn about data models, conceptualize and depict a database system, design systems using E-R diagrams, learn SQL and relational database design, understand internal storage structures using different file and indexing techniques, and grasp the concepts of transaction processing, concurrency control techniques, and recovery procedures.

Course Outcome:

- CO1: Apply E-R diagrams for an application.
CO2: Explain the creation of the normalized relational database model.
CO3: Analyze real-world queries to generate reports.
CO4: Determine whether a transaction satisfies the ACID properties.
CO5: Create and maintain an organization's database.

Course Content:

Module 1: Introduction [3L]

- Concept and overview of DBMS, data models.
- Database languages, database administrator, database users.
- Three-schema architecture of DBMS.

Module 2: Entity-Relationship and Relational Database Model [9L]

- Basic concepts, design issues.
- Mapping constraints, keys, entity-relationship diagram.
- Weak entity sets, extended E-R features.
- Case study on E-R model.
- Structure of relational databases, relational algebra.
- Relational calculus, extended relational algebra operations.
- Views, modifications of the database.

Module 3: SQL and Integrity Constraints [6L]

- Concept of DDL, DML, DCL.
- Basic structure, set operations, aggregate functions.
- Null values, domain constraints, referential integrity constraints.
- Assertions, views, nested sub-queries.
- Database security application development using SQL, stored procedures, and triggers.

Module 4: Relational Database Design [6L]

- Functional dependency, different anomalies in designing a database.
- Normalization using functional dependencies, decomposition, Boyce-Codd Normal Form, 3NF.
- Normalization using multi-valued dependencies, 4NF, 5NF.
- Case study.

Module 5: Internals of RDBMS [6L]

- Physical data structures.
- Query optimization: join algorithm, statistics, and cost-based optimization.
- Transaction processing, concurrency control, and recovery management.
- Transaction model properties, state serializability.

- Lock-based protocols, two-phase locking, deadlock handling.

Module 6: File Organization & Index Structures

[6L]

- File and record concept, placing file records on disk.
- Fixed and variable-sized records.
- Types of single-level index (primary, secondary, clustering).
- Multilevel indices, dynamic multilevel indices using B-tree and B+ tree.

Text/ Reference Books:

1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems", Addison Wesley Publishing.
2. C. J. Date, "Introduction to Database Management", Vol. I, II, III, AddisonWesley.
3. J. D. Ullman, "Principles of Database Systems", Galgottia Publication.
4. G. Jim and R. Address, "Transaction Processing: Concepts and Techniques", Morgan Kaufmann.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS 5003			
Course Title	Computer Networks			
Category	ENGG,Major			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Computer Organization and Architecture b)Operating Systems			

Learning Objective:

In this course, students will learn about the fundamental concepts of computer networking, with a detailed understanding of the TCP/IP protocol suite that drives the Internet. Various important network applications shall be discussed, providing students with a comprehensive understanding of how data flows through a real network and the various issues involved.

Course Outcome:

- CO1: Explain the fundamental concepts of data communication.
- CO2: Illustrate how the various protocols at the data link layer level work.

CO3: Explain the functionalities of the various protocols at the network and transport layer level.

CO4: Demonstrate how various internetworking devices can be used to connect different networks together.

CO5: Learn about various network applications with a particular emphasis on security.

Course Content:

Module 1: Introduction to Data Communication Techniques [5L]

- Data communication concepts, analog and digital signal transmission.
- Layered Network architecture—the OSI model.
- Transmission media (guided and unguided) and data transmission techniques (analog and digital).
- Signal encoding techniques – NRZ, NRZI, AMI, Manchester, Differential Manchester, etc.
- Circuit switching and packet switching, virtual circuits, and datagrams.

Module 2: Data Link Layer [7L]

- Framing and flow-control techniques.
- Stop-and-wait and sliding-window protocols for frame transmission, performance analysis.
- Error control techniques—checksum and CRC, stop-and-wait ARQ, Go-back-N, selective reject protocols.
- Multiple-access protocols: ALOHA, CSMA and CSMA/CD.
- IEEE 802.x Ethernet standard, switched Ethernet, Fast Ethernet, Gigabit Ethernet.
- Wireless LAN protocols and standards.

Module 3: Network Layer [8L]

- TCP/IP protocol suite, internetworking concepts.
- Internet Protocol (IP), IP addressing and routing, IP fragmentation and reassembly.
- IP subnets and masks—variable length subnet masks, classless inter-domain routing.
- Miscellaneous protocols—ARP and RARP, ICMP, BOOTP and DHCP.
- IPv6—basic differences from IPv4.

Module 4: Transport Layer [4L]

- Process-to-process delivery, TCP and UDP.
- TCP connection establishment and termination.
- Flow and congestion control in TCP—window advertisement, leaky-bucket and token-bucket algorithms.

Module 5: Internetworking Concepts [6L]

- Internetworking devices repeaters, hubs, bridges and routers.
- Interconnecting LANs using bridges, frame forwarding and address learning.
- Routing algorithms—shortest-path algorithm, distance vector algorithm, link state algorithm.

- RIP OSPF and BGP algorithms.

Module 6: Network Applications

[6L]

- Client-server concept.
- Introduction to DNS, SMTP, SNMP, FTP, TELNET and HTTP.
- Firewalls, Network Address Translator (NAT), Proxy Server, etc.
- Basic concepts of Cryptography–symmetric and asymmetric key crypto systems, Cryptographic hash functions.
- Digital signature, PGP, HTTPS.

Text/Reference Books:

1. W. Stallings, “Data and Computer Communication (5thEd.)”, PHI/Pearson Education.
2. B. A. Forouzan, “Data Communication and Networking (3rdEd.)”, Tata-McGraw-Hill.
3. W. R. Stevens, “UNIX Network Programming (3rdEd.)”, Prentice-Hall, Addison-Wesley.
4. A. Tanenbaum, “Computer Networks (4thEd.)”, PHI/ Pearson Education.
5. W. Stallings, “Cryptography and Network Security: Principles and Practice(4thEd.)”, PHI/Pearson Education.

CO-PO Mapping:

Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5004A			
Course Title	Compiler Design			
Category	ENGG, Major			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Formal Language and Automata Theory b) Computer Organization and Architecture c) Programming and Data Structure			

Learning Objective:

In this course, students will learn about the fundamental principles in compiler design, the algorithms and data structures involved in the construction of a compiler, and automation tools like lex and yacc for translating

high-level languages. At the end of the course, students will be able to build different phases of compilers.

Course Outcome:

CO1: Understand the lexical, syntactic, and semantic structures of a language.

CO2: Recall various techniques to modify the grammar of a given language.

CO3: Understand intermediate representations including symbol table, parse/syntax tree, and data structures required for such representations.

CO4: Understand different techniques for intermediate code and machine code optimization.

CO5: Implement various optimization techniques in the compiler design process.

Course Content:

Module 1: Lexical Analysis

[8L]

- History of Compiler Design
- Analysis of the Source Program
- The Phases of a Compiler
- Cousins of the Compiler
- The Grouping of Phases
- Compiler Construction Tools
- Need and role of lexical analyzer
- Lexical errors
- Input Buffering
- Specification of Tokens
- Recognition of Tokens
- Design of a Lexical Analyzer Generator
- Use of Lex tool

Module 2: Syntax Analysis

[9L]

- Need and role of the parser
- Context-Free Grammars
- Top-Down Parsing
- Recursive Descent Parser
- Predictive Parser
- LL(1) Parser
- Shift Reduce Parser
- LR Parser
- LR Item
- Construction of SLR Parsing table

- Introduction to LALR Parser
- Use of YACC / Bison tool
- Design of a syntax analyzer for a sample language

Module 3: Syntax Directed Translation

[7L]

- Syntax-directed Translation schemes
- Implementation of Syntax-directed Translators
- Intermediate code
- Postfix notation
- Parse trees & syntax trees
- Translation of assignment statements
- Boolean expressions
- Statements that alter the flow of control
- Postfix translation
- Translation with a top-down parser
- Translation: Array references in arithmetic expressions, procedure call, declarations, and case statements

Module 4: Code Generation

[6L]

- Data structure for symbol tables
- Representing scope information
- Three address code, quadruple & triples
- Issues in the design of code generator
- The target machine
- Runtime Storage management
- Basic Blocks and Flow Graphs
- Next-use Information
- A simple Code generator
- DAG representation of Basic Blocks

Module 5: Code Optimization

[6L]

- Sources of Optimization
- Peephole Optimization
- Optimization of basic Blocks
- Introduction to Global Data Flow Analysis
- Runtime Environments
- Source Language issues

- Storage Organization
- Storage Allocation strategies
- Access to non-local names
- Parameter Passing

Text/Reference Books:

1. A. Aho, V.R. Sethi, and D. J. Ullman, "Compilers Principles, Techniques and Tools", Pearson Education.
2. M.L. Scott, "Programming Language Pragmatics", Morgan Kaufmann Publishers.
3. C.N. Fischer, R.K. Cytron, and R.J. LeBlanc, "Crafting a Compiler", Addison-Wesley.
4. S. Chattopadhyay, "Compiler Design", Prentice-Hall of India.
5. A.W. Appel, "Modern Compiler Implementation in C", Cambridge University Press.
6. R. Mark, "Writing Compilers and Interpreters: A Modern Software Engineering Approach Using Java", Wiley Publishing.
7. K.D. Cooper and L. Torczon, "Engineering a Compiler", Morgan Kaufmann Publishers.
8. A.I. Holub, "Compiler Design in C", Prentice-Hall of India.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5004B			
Course Title	Cryptography and Network Security			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Data Structures and Algorithms b) Operating Systems c) Discrete Structures			

Learning Objective:

In this course, students will learn about various cryptographic techniques essential for understanding how secure information systems can be built. The course will discuss various security applications as case studies, helping students strengthen their basic knowledge in cybersecurity.

Course Outcome:

CO1: Explain the basic concept of cryptography and its applications in network security.

CO2: Learn and analyze various private-key cryptography algorithms.

CO3: Learn and analyze various public-key cryptography algorithms.

CO4: Explain various cryptographic hash functions and their applications in network security.

CO5: Demonstrate how the basic concepts of cryptography can be used to develop practical security applications.

Course Content:**Module 1: Introduction to Cryptography and Block Ciphers [4L]**

- Introduction to security attacks, services, and mechanisms.
- Conventional encryption models: private-key and public-key cryptography.
- Classical encryption techniques: substitution and transposition ciphers.

Module 2: Private-key Cryptography [7L]

- Block Cipher: Feistel structure, Shannon's theory of confusion and diffusion, DES, triple-DES, AES.
- Linear and differential cryptanalysis: basic concepts.
- Key distribution problem.
- Stream Cipher: basic concept, realization based on linear feedback shift register.

Module 3: Mathematical Background [7L]

- Modular arithmetic, Fermat's and Euler's theorem, gcd, primality testing.
- Euclid's algorithm, Chinese remainder theorem.
- Intractable problems: integer factorization problem, modular square root problem, discrete logarithm problem.

Module 4: Public-key Cryptography [6L]

- RSA algorithm, security of RSA, key management.
- Diffie-Hellman key exchange algorithm.
- Elliptic curve cryptography: basic concepts.

Module 5: Cryptographic Hash Functions and Authentication [5L]

- Properties of hash functions: MD5 message digest algorithm, secure hash algorithm (SHA-1).
- Digital signatures: authentication protocols, various approaches, digital signature standard (DSS).

Module 6: Network Security [7L]

- Authentication applications: Kerberos, X.509 directory authentication service.

- Electronic mail security: pretty good privacy (PGP), S/MIME.
- Certification: public-key infrastructure.
- Secure socket layer (SSL), transport layer security, secure HTTP (HTTPS), and other secure protocols on the Internet.
- System security: viruses, worms, and malware, firewall systems.

Text/Reference Books:

1. W. Stallings, "Cryptography and Network Security: Principles and Practices", Prentice-Hall of India.
2. J. Menezes, P.C. van Oorschot, and S.A. Vanstone, "Handbook of Applied Cryptography", CRC Press.
3. D. Stinson, "Cryptography: Theory and Practice", CRC Press.
4. C. Kaufman, R. Perlman, and M. Speciner, "Network Security", Pearson Education.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5004C			
Course Title	Computer Graphics			
Category	ENGG, Major			
LTP& Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a. Mathematical Foundation b. Programming Languages			

Learning Objectives:

This course provides an introduction to the principles of computer graphics. In particular, the course will consider methods for modeling 2-D objects and generating photorealistic renderings on color raster graphics devices. The emphasis will be on understanding how various elements like algebra, geometry, algorithms, and data structures interact in the design of graphics. Additionally, this course provides an idea of hardware system

architecture for computer graphics, including graphics pipeline, frame buffers, and graphic coprocessors.

Course Outcome:

CO1: Students will describe fundamental algorithms used in computer graphics and compare and evaluate them to some extent.

CO2: Students will work and interact, through hands-on experiences, to design, develop, and modify electronically generated imagery using a wide range of sophisticated graphical tools and techniques.

CO3: Students will summarize different hidden surface elimination algorithms and shading techniques used in computer graphics and digital media production.

CO4: Students will explain the technology necessary for creating multimedia content for the web, video, DVD, 2D and 3D graphics, sound, and programming.

CO5: Students can apply knowledge, techniques, skills, and modern tools to become successful professionals in communication and media industries.

Course Content:

Module 1: Introduction

[8L]

- Application areas of Computer Graphics
- Overview of graphics systems
- Video display devices
- Raster-scan systems
- Random scan systems
- Graphics monitors and workstations
- Input devices
- Output primitives: Points and lines
- Line drawing algorithms
- Mid-point circle and ellipse algorithms
- Filled area primitives: Scan line polygon fill algorithm, boundary-fill, and flood-fill algorithms.

Module 2: 2-D Geometrical Transforms

[8L]

- Translation, scaling, rotation, reflection, and shear transformations
- Matrix representations and homogeneous coordinates
- Composite transforms
- Transformations between coordinate systems
- 2-D Viewing: The viewing pipeline
- Viewing coordinate reference frame
- Window to view-port coordinate transformation
- Viewing functions
- Cohen-Sutherland clipping algorithms

- Sutherland-Hodgeman polygon clipping algorithm.

Module 3: 3-D Object Representation

[6L]

- Polygon surfaces
- Quadric surfaces
- Spline representation
- Hermite curve, Bezier curve, and B-spline curves
- Bezier and B-spline surfaces
- Basic illumination models
- Polygon rendering methods.

Module 4: Geometric Transformations

[6L]

- 3-D Geometric transformations: Translation, rotation, scaling, reflection, and shear transformations
- Composite transformations
- 3-D viewing: Viewing pipeline
- Viewing coordinates
- View volume and general projection transforms and clipping.

Module 5: Computer Animation

[8L]

- Design of animation sequence
- General computer animation functions
- Raster animation
- Computer animation languages
- Keyframe systems
- Motion specifications
- Visible-Surface Determination Techniques for efficient Visible-Surface Algorithms
- Categories of algorithms
- Back-face removal
- The z-Buffer Algorithm
- Scan-line method
- Painter's algorithms.

Text/Reference Books:

1. "Computer Graphics C version" by Donald Hearn and M. Pauline Baker, Pearson Education.
2. "Computer Graphics Second edition" by Zhigang Xiang, Roy Plastock, Schaum's Outlines, Tata McGraw Hill edition.
3. "Computer Graphics Principles & Practice" (Second edition in C) by Foley, Van Dam, Feiner, and Hughes, Pearson Education.

4. "Procedural Elements for Computer Graphics" (Second edition) by David F. Rogers, Tata McGraw Hill.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	-	-	2	-	-	-	0	0	3	0	0	0	1	0	0
CO2	2	2	-	-	-	-	0	0	0	0	0	0	1	2	0
CO3	2	-	1	-	3	-	0	0	1	0	0	0	2	0	0
CO4	2	2	-	2	-	1	0	0	1	0	0	0	0	0	0
CO5	1	2	-	-	-	-	0	0	2	0	0	0	1	0	0

Course Code	YED5001			
Course Title	Economics for Engineers			
Category	HUM, Minor			
LTP & Credits	L	T	P	Credits
	2	0	0	2
Total Contact Hours	24			
Pre-requisites	None			

Learning Objective:

In this course, students will learn about managerial economics, basics of accounting, and financial management. By the end of the course, students will be able to make different managerial decisions in terms of economics, solve financial statements, and make different financing decisions for businesses and at a personal level.

Course Outcome:

CO1: Apply appropriate engineering economics analysis methods for problem-solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.

CO2: Evaluate the cost-effectiveness of individual engineering projects using the learned methods and draw inferences for investment decisions.

CO3: Compare the life cycle cost of multiple projects using the learned methods and make a quantitative decision between alternate facilities and/or systems.

CO4: Evaluate the profit of a firm, carry out break-even analysis, and employ this tool to make production decisions.

CO5: Discuss and solve advanced economic engineering analysis problems including taxation and inflation.

Course Content:

Module 1: Introduction

[3L]

- Managerial Economics
- Relationship with other disciplines
- Firms: Types, Objectives, and goals
- Managerial Decisions-Decision Analysis

Module 2: Demand and Supply Analysis [5L]

- Demand: Types, determinants, function, elasticity, forecasting
- Supply: Determinants, function, elasticity

Module 3: Cost Analysis [5L]

- Elements of costs
- Marginal cost, Marginal Revenue
- Sunk cost, Opportunity cost
- Break-even analysis–PV ratio

Module 4: Elementary Economic Analysis [4L]

- Inflation: Meaning, types, causes, measures to control
- National Income: Definition, Concepts, Method of measuring

Module 5: Financial Accounting [5L]

- Concepts and Definition of Accounting
- Journal, Ledger, Trial Balance
- Trading A/C, Profit & Loss A /C, Balance Sheet

Module 6: Investment Decision [2L]

- Time value of money: Interest - Simple and compound, nominal and effective rate of interest
- Cash flow diagrams
- Principles of economic equivalence
- Evaluation of engineering projects: Present worth, Future worth, Annual worth, Internal rate of return, Cost-benefit analysis for public projects

Text/Reference Books:

1. B. Riggs and S.U. Randhwa, "Engineering Economics", McGraw Hill Education India.
2. D. Vengedasalam and K. Madhavan, "Principles of Economics", Oxford University Press.
3. W.G. Sullivan, E.M. Wicks, and C.P. Koelling, "Engineering Economy", Pearson.
4. R.P. Seelvan, "Engineering Economics", Prentice-Hall of India.
5. H.L. Ahuja, "Principles of Micro Economics", S. Chand & Company Ltd.
6. S.P. Gupta, "Macro Economics", Tata McGraw Hill.
7. K.K. Dewett, "Modern Economic Theory", S.Chand & Company Ltd.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5101			
Course Title	Artificial Intelligence Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a) Data Structures and Algorithms b) Database Management System c) Programming Practices II			

Learning Objective:

In this course, students will learn the basic principles, techniques, and applications of Artificial Intelligence and Machine Learning for problem-solving, inference, perception, knowledge representation, and puzzles design.

Course Outcomes:

CO1: Explain the working principles of PROLOG/LISP and apply LIST structure of PROLOG.

CO2: Apply reasoning and inference principles to real-world problems and design programs to solve various puzzles.

CO3: Design simple algorithms for data classification in Python/R and test them with benchmark datasets.

CO4: Design simple algorithms for data clustering in Python/R and test them with benchmark datasets.

CO5: Analyze and evaluate algorithms for estimation/prediction using regression.

Course Content:

Suggestive List of Experiments:

In this laboratory, students will be familiarized with PROLOG/LISP language. The experiments are structured into four modules.

1. Module 1 (4 days):

- Introduction to PROLOG facts & rules using a simple family tree.
- Explanation of how goals are given in PROLOG and simple queries on the family tree.
- Formation of recursive definitions and how PROLOG executes goals.
- Implementation of Graph Search algorithms like DFS, BFS.
- Implementation of well-known puzzles like the 8-queens problem, Towers-of-Hanoi problem, etc.

2. Module 2 (4 days):

- Implementation of Classifiers: KNN, Naive Bayes Classifier, Decision Tree, SVM, Perceptron, Multi-Layer Perceptron, Random Forest, etc., on Python/R platform and test them on benchmark datasets.
- Familiarization with ML Tools: Excel, WEKA, R, Python for classification.

3. Module 3 (3 days):

- Implementation of data clustering algorithms: K-Means, DBSCAN, Hierarchical (AGNES/DIVISIVE), etc., on Python/R platform and test them on benchmark datasets.
- Familiarization with ML Tools: Excel, WEKA, R, Python for clustering.

4. Module 4 (1 day):

- Implementation of Regression (single and Multiple Variables) linear and non-linear, Logistic regression for prediction tasks.

Text/Reference Books:

1. I. Bratko, "Prolog programming for artificial intelligence", Pearson Education.
2. S. Kaushi, "Logic and Prolog Programming", New Age International Publishers.
3. B. Lantz, "Machine learning with R", PACKT Publishing.
4. C. M. Andreas and S. Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5102			
Course Title	Database Management System Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	a)Digital Circuits Laboratory			

Learning Objective:

This course aims to enable students to learn about data models, conceptualize and depict a database system, understand the fundamental concepts of SQL queries, design a database with the necessary attributes, and learn the methodology of accessing, modifying, and updating data and information from relational databases. Additionally, students will learn database design, designing user interfaces, and how to connect with databases.

Course Outcome:

- CO1:To understand the basic concepts regarding databases and SQL queries.
- CO2:To explain the concepts of PL/SQL.
- CO3:To differentiate between DBMS and advanced DBMS.
- CO4:To analyze database system concepts and apply normalization to the database.
- CO5:To apply and create different transaction processing and concurrency control applications.

Course Content:

1. Experiments on fundamentals of database systems:
 - Creating a Database
 - Creating a Table
 - Specifying Relational Data Types
 - Specifying Constraints
 - Creating Indexes (Duration: 2 days)
2. Experiments on database Tables and Record handling:
 - INSERT statement
 - Use of SELECT and INSERT together
 - DELETE, UPDATE, TRUNCATE statements
 - DROP, ALTER statements (Duration: 2 days)
3. Experiments on retrieving data from the database:
 - The SELECT statement

- Use of the WHERE clause
- Use of the Logical Operators in the WHERE clause
- Use of IN, BETWEEN, LIKE, ORDER BY, GROUP BY, and HAVING Clause
- Use of the Aggregate Functions
- Combining tables using JOINS
- Sub-queries (Duration: 3 days)

4. Experiments on Miscellaneous Database Management:

- Creating Views
- Creating Column Aliases
- Creating Database Users
- Use of GRANT and REVOKE (Duration: 1 day)

5. Experiments on PL/SQL:

- Use of decision-making statements
- Different loop structures to solve simple programs (e.g., sum of few numbers, pattern prints, etc.)
- Inserting values into tables, reading data from a table
- Basic working with CURSORS (Duration: 1 day)

6. Innovative Experiments:

- Case study of handling complex databases (e.g., College Management System, Hospital Management System, Library Management System, Payroll Management System, etc.) (Duration: 3 days)

Text/Reference Books:

1. H.F. Korth and A. Silberschatz, "Database System Concepts", McGraw Hill.
2. E. Ramez and S. Navathe, "Fundamentals of Database Systems", Benjamin Cummings Publishing Company.
3. C.J. Date, "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
4. G. Jim and R. Address, "Transaction Processing: Concepts and Techniques", Moragan Kaufmann.
5. J.D. Ullman, "Principles of Database Systems", Galgottia Publication.
6. I. Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS5103				
Course Title	Computer Networks Laboratory				
Category	ENGG, Major				
LTP& Credits	L	T	P	Credits	
	0	0	3	1.5	
Total Contact Hours	36				
Pre-requisites	c. Operating Systems Laboratory d. Computer Organization and Architecture Laboratory				

Learning Objective:

In this laboratory course, students will learn network programming using the socket API system calls and analyze packets flowing over the network. Additionally, they will simulate several algorithms at the data link and network layers and analyze the results.

Course Outcome:

CO1: To learn how to use socket API system calls for network programming.

CO2: To learn how to capture network packets and analyze them.

CO3: To analyze various algorithms at the data link and network layers through simulation.

CO4: To understand and apply error detection and correction techniques in network communication.

CO5: To design and implement simple network protocols.

Course Content:

Suggestive List of Experiments:

1. Familiarization with Berkeley socket interface system calls in C, and writing programs to communicate between two machines using both connection-oriented (TCP) and connectionless (UDP) protocols. [3 days]
2. Write programs in C to simulate the stop-and-wait and sliding-window protocols, and carry out performance analyses both in the absence of errors and also in the presence of errors. [2 days]
3. Familiarization with a packet capturing and analysis tool (like Wireshark), and analyze packets as captured under various data transfer scenarios over the network. [2 days]
4. Write a program in C to simulate a router for filtering packets (make the specification of the problem as realistic as possible). [3 days]

- Write programs to implement the distance vector algorithm for building up the routing tables in a network of routers. [2 days]

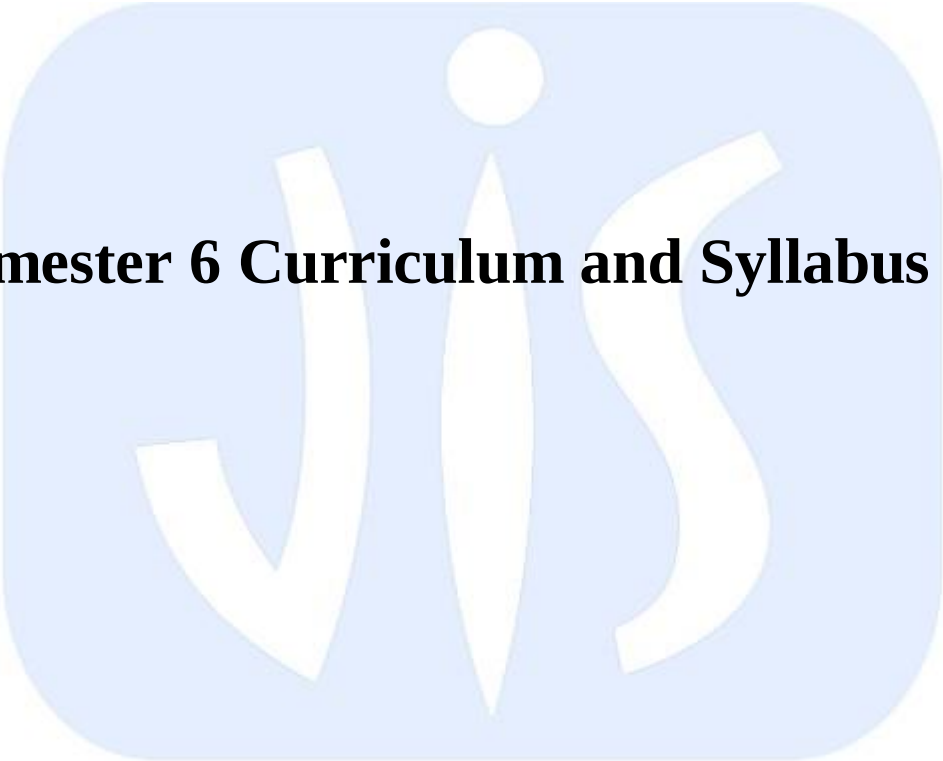
Text/Reference Books:

- W. Stallings, "Data and Computer Communication (5th Ed.)", PHI/Pearson Education.
- B. A. Forouzan, "Data Communication and Networking (3rd Ed.)", Tata-McGraw-Hill.
- W. R. Stevens, "UNIX Network Programming (3rd Ed.)", Prentice-Hall, Addison-Wesley.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



The logo for JIS University features the letters 'JIS' in a stylized, white, sans-serif font. The 'J' and 'S' have a modern, slightly curved design. The letters are set against a light blue rounded rectangular background. Below this, the word 'UNIVERSITY' is written in a smaller, light blue, all-caps sans-serif font, centered between two horizontal light blue lines.

Semester 6 Curriculum and Syllabus

Course Code	YCS6001			
Course Title	Machine Learning			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	a) Probability and Statistics b) Design and Analysis of Algorithms			

Learning Objective:

The course covers some of the important regression, classification, clustering, rule-based, and probabilistic models and algorithms. It includes themes like linear and logistic regression, regularization, decision trees, probabilistic models, SVMs, neural networks, clustering, and reduction in feature dimensionality.

Course Outcome:

CO1: To explain and formulate machine learning problems corresponding to different applications.

CO2: To classify machine learning algorithms and analyze their strengths and weaknesses.

CO3: To explain the basic theory underlying machine learning.

CO4: To apply machine learning algorithms to solve problems of moderate complexity.

CO5: To design and implement machine learning models using popular machine learning libraries and frameworks such as scikit-learn, TensorFlow, or PyTorch.

Course Content:

Module 1: Introduction to Machine-based Learning

[8L]

Applications and problems, learning scenarios, concepts of tasks (problems to be solved by machine learning), models (output of machine learning), and features (workhorses of machine learning), geometric models, probabilistic models, logical models.

Module 2: Binary and Multi-class Classification

[7L]

Binary classification, assessing and visualizing performance of classification, scoring and ranking, turning rankers into classifiers, class probability estimation. Multiclass classification, multiclass scores and probabilities, regression, unsupervised and descriptive learning, predictive and descriptive clustering.

Module 3: Rule Learning and Decision Trees

[9L]

Decision trees, ranking and probability estimation trees, tree learning as variance reduction, regression trees, learning ordered rule lists, learning unordered rule sets, descriptive rule learning, rule learning for subgroup discovery, association rule mining, first-order rule learning, Least squares method, multivariate linear regression, regularized regression.

Module 4: Linear Models for Classification and Clustering

[8L]

Perceptron, support vector machine, soft margin SVM, probabilities from linear classifiers, beyond linearity with kernel methods, Nearest neighbor classification, distance-based clustering, K-means algorithm,

Hierarchical clustering, Normal distribution, probabilistic models for categorical data, naive Bayes model for classification, probabilistic models with hidden variables, Gaussian mixture model, compression-based model.

Module 5: Feature Processing

[8L]

Types of features, calculation on features, categorical, ordinal, and quantitative features, structured features, thresholding and discretization, normalization and calibration, incomplete features, feature selection - matrix transformations and decompositions.

Module 6: Other Machine Learning Topics of Interest

[8L]

Bagging and random forests, boosted rule learning, mapping the ensemble landscape - bias, variance, and margins, metalearning. What to measure, how to measure, how to interpret, interpretation of results over multiple datasets.

Text/Reference Books:

1. P. Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press.
2. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press.
3. K. P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6002			
Course Title	Digital Image Processing			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	c) Probability and Statistics d) Design and Analysis of Algorithms			

Learning Objective:

The main objective of image processing is to transform an image into digital form and perform certain operations on it in order to obtain specific models or to extract useful information from the image.

Course Outcome:

CO1: Upon successfully completing the course, the students should:

CO2: Have an appreciation of the fundamentals of Digital Image Processing including the topics of filtering, transforms and morphology, and image analysis and compression.

CO3: Be able to implement basic image processing algorithms in MATLAB.

CO4: Have the skill base necessary to further explore advanced topics of Digital Image Processing.

CO5: Be in a position to make a positive professional contribution in the field of Digital Image Processing.

Course Content:

Module 1: Image Fundamentals

[7L]

Digital image fundamentals & Image Transforms: Digital Image fundamentals, Sampling and quantization, Relationship between pixels. Image Transforms: 2-D FFT, Properties. Walsh transform, Hadamard Transform, Discrete cosine Transform, Discrete Wavelet Transform.

Module 2: Image Enhancement

[8L]

Image enhancement (spatial domain): Introduction, Image Enhancement in Spatial Domain, Enhancement Through Point Operation, Types of Point Operation, Histogram Manipulation, gray level Transformation, local or neighborhood operation, median filter, spatial domain high-pass filtering. Image enhancement (Frequency domain): Filtering in Frequency Domain, Obtaining Frequency Domain Filters from Spatial Filters, Generating Filters Directly in the Frequency Domain, Low Pass(smoothing) and High Pass (sharpening) filters in Frequency Domain

Module 3: Image Restoration

[6L]

Image Restoration: Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration.

Module 4: Image segmentation

[6L]

Image segmentation: Detection of discontinuities. Edge linking and boundary detection, Thresholding, Region-oriented segmentation Morphological Image Processing: Dilation and Erosion, Dilation, Structuring Element Decomposition, Erosion, Combining Dilation and Erosion, Opening and Closing, The Hit or Miss Transformation.

Module 5: Image Compression

[9L]

Image Compression: Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Huffman and Arithmetic Coding, Error-Free Compression, Lossy Compression, Lossy and Lossless Predictive Coding, Transform Based Compression, JPEG 2000 Standards.

Text Books:

1. Digital Image Processing - Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. Digital Image Processing - S Jayaraman, S. Essakkirajan, T. Veerakumar-TMH, 2010

Reference Books:

1. Digital Image Processing and analysis-human and computer vision application with using CVIP Tools - Scotte Umbaugh, 2nd Ed, CRC Press, 2011
2. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology
3. Fundamentals of Digital Image Processing - A.K. Jain, PHI, 1989
4. Digital Image Processing and computer Vision - Somka, Halavac, Boyle - Cengage learning (Indian edition) 2008,
5. Digital Image Processing using Matlab, Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson Education.
6. Introduction to Image Processing & Analysis - John C. Russ, J. Christian Russ, CRC Press, 2010
7. Digital Image Processing with MATLAB & Labview - Vipula Singh Elsevier

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6003				
Course Title	Natural Language Processing				
Category	ENGG,Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	a) Design and Analysis of Algorithms b) Compiler Design				

Learning Objective:

In this course, students will learn about various Natural Language Processing techniques essential for understanding how to build Language Processing systems. Specifically, various security applications shall

be discussed as case studies. The course will be very helpful for students in strengthening their basic knowledge in Language Processing.

Course Outcome:

CO1: To explain the basic concept of NLP and its applications.

CO2: To learn and analyze various NLP Tools.

CO3: To learn and analyze various NLP Concepts.

CO4: To apply the basic understanding of NLP in real language processing environments.

CO5: To design and implement a natural language processing system for a specific application, demonstrating proficiency in using NLP techniques and tools.

Course Content:

Module 1: Introduction to NLP

[7L]

Introduction: Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes. Linguistics resources - Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet, etc. Resource management with XML.

Module 2: Management of Linguistic Data

[7L]

Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF.

Module 3: Speech Tagging and Applications

[8L]

Part of Speech tagging: Stochastic POS tagging, HMM, Transformation-based tagging (TBL), Handling of unknown words, named entities, multiword expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect, and mood, and agreement, Context-Free Grammar, spoken language syntax.

Module 4: Parsing

[8L]

Parsing: Unification, probabilistic parsing, TreeBank. Semantics: Meaning representation, semantic analysis, lexical semantics, WordNet Word Sense Disambiguation - Selection restriction, machine learning approaches, dictionary-based approaches.

Module 5: Discourse and Applications of NLP

[6L]

Discourse: Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure. Applications of NLP: Spell-checking, Summarization, Information Retrieval - Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation – Overview.

Text/Reference Books:

1. D. Jurafsky and J. H. Martin. "Speech and Language Processing", Pearson Education.
2. A. James, "Natural Language Understanding", Pearson Education.
3. A. Bharati, R. Sangal, and V. Chaitanya, "Natural Language Processing: a Paninian Perspective", Prentice-Hall of India.
4. T. Siddiqui and U. S. Tiwary, "Natural Language Processing and Information Retrieval", OUP.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6004C				
Course Title	Cloud Computing				
Category	ENGG,Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	a) Computer Networks b) Operating Systems				

Learning Objective:

To provide students a sound foundation of cloud computing so that they are able to start using and adopting Cloud Computing services and tools in their real-life scenarios. To enable students to explore some important cloud computing-driven commercial systems and applications.

Course Outcome:

CO1: To explain the Cloud architecture, different services, and deployment models.

CO2: To learn the concepts of abstraction and different types of virtualization.

CO3: To identify and explain different cloud offerings with their usage, namely Azure, Google Apps, Amazon Web Services.

CO4: To explain the underlying concepts of cloud management and security and illustrate the use of Service-Oriented Architecture (SOA).

CO5: To analyze and compare different cloud computing providers and services, evaluating their performance, cost-effectiveness, and suitability for specific use cases.

Course Content:

Module 1: Definition of Cloud Computing and its Basics

[8L]

- Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid, and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/service providers, Cloud Reference model Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing.
- Cloud Architecture: A brief introduction to Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients.
- Services and Applications by Type IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos.
- PaaS – Basic concept, tools, and development environment with examples.
- SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platforms.
- Identity as a Service (IDaaS).
- Compliance as a Service (CaaS).

Module 2: Use of Platforms in Cloud Computing

[8L]

- Concepts of Abstraction and Virtualization.
- Virtualization technologies: Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D).
- Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of the use of load balancing.
- Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF).
- Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance.

Module 3: Use of various Web Services

[7L]

- Concepts of Platform as a Service: Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com).
- Application development Use of PaaS Application frameworks.
- Use of Google Web Services: Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.
- Use of Amazon Web Services: Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon SimpleDB and Relational Database Service.

- Use of Microsoft Cloud Services: Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services.

Module 4: Cloud Infrastructure

[6L]

- Types of services required in implementation – Consulting, Configuration, Customization, and Support.
- Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors.
- Monitoring of an entire cloud computing deployment stack – an overview with mention of some products.
- Lifecycle management of cloud services (six stages of lifecycle).
- Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards).

Module 5: Concepts of Services and Applications

[7L]

- Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs.
- Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs.
- Cloud-based Storage: Cloud storage definition – Manned and Unmanned Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services.

Text/Reference Books:

1. B. Sosinsky, "Cloud Computing Bible (1st Ed.)", Wiley.
2. R. Buyya, C. Vecchiola, S. T. Selvi, "Mastering Cloud Computing (2nd Ed.)", McGraw Hill Education.
3. A.T. Velte, "Cloud computing: A practical approach (3rd Ed.)", Tata McGraw Hill.
4. C. Miller, "Cloud Computing (4th Ed.)", PHI/Pearson Education.
5. K. Saurabh, "Cloud Computing (2nd Ed.)", Wiley.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6004A				
Course Title	Mobile computing				
Category	ENGG,Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	c) Computer Networks d) Operating Systems				

Learning Objective:

Mobile computing enables connecting portable devices to wireless networks to access data and use services while moving. Mobile communication involves the infrastructure that is used to wirelessly transmit and receive data between devices seamlessly and safely.

Course Outcome:

CO1: Understanding of Wireless Communication Fundamentals
CO2: Knowledge of Telecommunication Networks and Wireless LAN
CO3: Proficiency in Mobile Network and Transport Layer Protocols
CO4: Ability to Implement Mobile Application Layer Protocols
CO5: Understanding of Database Issues in Mobile Computing

Course Content:

Module 1: Wireless Communication Fundamentals

[7L]

Cellular systems - Frequency Management and Channel Assignment - types of handoff and their characteristics, dropped call rates & their evaluation - MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.

Module 2: Telecommunication Networks & Wireless LAN**[8L]**

Telecommunication systems – GSM – GPRS - Satellite Networks, Wireless LAN – IEEE 802.11 - Architecture – services – MAC – Physical layer – IEEE 802.11a-802.11b standards – HIPERLAN – BlueTooth.

Module 3: Mobile Network Layer & Transport Layer**[7L]**

Mobile IP – Dynamic Host Configuration Protocol - Routing – DSDV – DSR – Alternative Metrics. Traditional TCP, Mobile TCP.

Module 4: Application Layer WAP**[8L]**

Model - Mobile Location-based services - WAP Gateway – WAP protocols – WAP user agent profile-caching model-wireless bearers for WAP - WML – WML Scripts.

Module 5: Database Issues**[6L]**

Database Issues: Hoarding techniques, caching invalidation mechanisms, client-server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues.

Text/Reference Books:

1. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education, 2003.
2. William Stallings, “Wireless Communications and Networks”, Pearson Education, 2002.
3. Kaveh Pahlavan, Prasanth Krishnamoorthy, “Principles of Wireless Networks”, PHI/Pearson Education, 2003.
4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons, and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.
5. Raj Kamal, “Mobile Computing”, Oxford University Press, 2007.
6. Asoke K. Talukdar, “Mobile Computing”, Tata McGraw-Hill Education, 2010.
7. Mohammad Ilyas, Imad Mahgoub, ”Mobile Computing Handbook”, AUERBACH, 2004.
8. Vilas S. Bagad, “Mobile Computing Introduction”, Technical Publications, 2014.
9. DR SANJAY Sharma, “Mobile Computing”, S.K. Kataria & Sons Publication, 2014.
10. Dr. Ashish N. Jani, Dr. N.N. Jani, Neeta Kanabar, ”Mobile Computing-Technologies and Applications”, 2010.
11. Pattnaik, Prasant Kumar, Mall, Rajib, “Fundamentals of Mobile Computing”, Second Edition, PHI Learning Pvt. Ltd., 2015.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
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Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6004B				
Course Title	Quantum computing				
Category	ENGG,Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	e) Computer Networks f) Operating Systems				

Learning Objective:

This course will introduce you to the basics of quantum computing through a practical approach. Participants will learn about qubits and gating operations, construct quantum circuits and learn about quantum algorithms.

Course Outcome:

CO1: Provide a basic introduction to quantum mechanics, including linear algebra and the Dirac notation, to establish foundational understanding.

CO2: Introduce quantum computation and quantum information, covering topics such as quantum entanglement, quantum algorithms, and quantum channels.

CO3: Explore rudimentary quantum computing using the IBM quantum computer and associated simulators.

CO4: Discuss quantum correlations, including Bell inequalities, entanglement, Schmidt decomposition, super-dense coding, and teleportation.

CO5: Cover quantum cryptography, specifically quantum key distribution.

Course Content:

Module 1: Introduction to Quantum Mechanics

[7L]

- Elementary quantum mechanics
- Linear algebra for quantum mechanics
- Quantum states in Hilbert space
- The Bloch sphere

- Density operators
- Generalized measurements
- No-cloning theorem

Module 2: Quantum Correlations

[8L]

- Bell inequalities and entanglement
- Schmidt decomposition
- Super-dense coding
- Teleportation

Module 3: Quantum Cryptography

[7L]

- Quantum key distribution

Module 4: Quantum Gates and Algorithms

[6L]

- Universal set of gates
- Quantum circuits
- Solovay-Kitaev theorem
- Deutsch-Jozsa algorithm
- Factoring

Module 5: Programming a Quantum Computer

[8L]

- Introduction to IBM Quantum Experience (IBMQ)
- Coding a quantum computer using a simulator for basic quantum measurement and state analysis

Text Books:

1. Phillip Kaye, Raymond Laflamme et. al., "An Introduction to Quantum Computing," Oxford University Press, 2007.
2. Chris Bernhardt, "Quantum Computing for Everyone," The MIT Press, Cambridge, 2020.
3. David McMahon, "Quantum Computing Explained," Wiley-Interscience, IEEE Computer Society, 2008.

References:

1. M. A. Nielsen & I. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press, 2013.
2. Eleanor G. Rieffel and Wolfgang H. Polak, "Quantum Computing: A Gentle Introduction," MIT Press, 2014.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YLB6001				
Course Title	Cyber Law and Ethics				
Category	ENGG,Minor				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	None/if any				

Learning Objective:

Cyber law provides a framework for protecting individuals and organizations from cyber threats, ensuring the privacy and security of digital transactions, and establishing guidelines for ethical and legal conduct in cyberspace.

Course Outcome:

CO1: Understand the evolution of computer technology and the emergence of cyberspace, including the legal and technological significance of domain names and the Internet as a tool for global access.

CO2: Analyze the Information Technology Act, 2000, its amendments, limitations, and provisions related to digital signatures, cryptographic algorithms, electronic records, and certifying authorities.

CO3: Evaluate cyber laws and related legislation, including patent law, trademark law, copyright, and their implications for software, domain names, electronic databases, and civil and criminal procedures.

CO4: Examine electronic business and legal issues, including the evolution of e-commerce, paperless contracts, e-commerce models (B2B, B2C), e-security, taxation, electronic payments, supply chain, and emerging trends.

CO5: Discuss the importance of cyber ethics, the need for cyber regulations, and ethical issues in information society, artificial intelligence, and blockchain technologies.

Course Content:

Module 1: Introduction to Cyber Law

[7L]

Evolution of computer technology, emergence of cyberspace. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Webpace, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.

Module 2: Information Technology Act

[7L]

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

Module 3: Cyber Law and Related Legislation

[8L]

Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic DataBase and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution, Online Dispute Resolution (ODR).

Module 4: Electronic Business and Legal Issues

[7L]

Evolution and development in E-commerce, paper vs paperless contracts E-Commerce models-B2B, B2C, E-security. Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends.

Module 5: Cyber Ethics

[7L]

The Importance of Cyber Law, Significance of Cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Blockchain Ethics.

Text/Reference Books:

1. Cyber Laws: Intellectual property & E-Commerce, Security-Kumar K, Dominant Publisher
2. Cyber Ethics 4.0, Christoph Stuckelberger, Pavan Duggal, by Globethic
3. Information Security policy & Implementation Issues, NIIT, PHI
4. Computers, Internet and New Technology Laws, Karnika Seth, Lexis Nexis Butterworths Wadhwa Nagpur.
5. Legal Dimensions of Cyber Space, Verma S, K, Mittal Raman, Indian Law Institute, New Delhi,
6. Cyber Law, Jonthan Rosenoer, Springer, New York, (1997).

CO-PO Mapping:

Course Outcome (CO)	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	PSO -3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6101				
Course Title	Machine Learning Laboratory				
Category	ENGG, Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	None/if any				

Learning Objective:

The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python.

Course Outcomes:

After the completion of the course the student can able to:

CO1: Understand complexity of Machine Learning algorithms and their limitations;

CO2: Understand modern notions in data analysis-oriented computing;

CO3: Be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;

CO4: Be capable of performing experiments in Machine Learning using real-world data.

Course Contents:**List of Experiments**

1. The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)

2. Extract the data from database using python
3. Implement k-nearest neighbours classification using python
4. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k- means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

5. The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

Medium skiing design single twenties no->high Risk high golf trading married forties yes ->low Risk

low speed way transport married thirties yes->med Risk medium football banking single thirties yes ->low Risk high flying media married fifties yes ->high Risk

low football security single twenties no->med Risk medium golf media single thirties yes ->med Risk medium golf transport married forties yes ->low Risk high skiing banking single thirties yes ->high Risk low golf unemployed married forties yes->high Risk

Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset?

6. Implement linear regression using python.
7. Implement Naïve Bayes theorem to classify the English text
8. Implement an algorithm to demonstrate the significance of genetic algorithm
9. Implement the finite words classification system using Back-propagation algorithm

Course Outcome (CO)	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	PSO -3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6102				
Course Title	Digital Image Processing Laboratory				
Category	ENGG, Major				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites	None/if any				

Learning Objectives:

To introduce the concepts of image processing and basic analytical methods to be used in image processing. To familiarize students with image enhancement and restoration techniques, To explain different image compression techniques. To introduce segmentation and morphological processing techniques.

Course Outcome:

CO1: Image Processing Fundamentals
CO2: Image Enhancement Techniques
CO3: Image Classification and Analysis
CO4: Image Fusion and Feature Extraction
CO5: Accuracy Assessment and Applications

Course Contents:

Exercises:

1. Image reading and writing

2. Pre-processing techniques: radiometric correction
3. Random and Periodic Noise removal
4. Pre-processing techniques: Ground control and rectification
5. Enhancements – histogram, filters
6. Band rationing and normalization – NDVI, SAVI & NDWI
7. PCA
8. Image fusion
9. Classification –supervised &unsupervised
10. Sub-pixel classification
11. Classification using Neural Network and Fuzzy Logic
12. Accuracy assessment – correlation, RMSE & kappa
13. Crop conditioning assessment/ inundation damage assessment/ forest fire/ change dynamic analysis

Text /Reference Book:

1. Richards, Remote sensing digital Image Analysis –An Introduction Springer-Verlag 1993.

CO-PO Mapping:

Course Outcome (CO)	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	PSO -3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6103			
Course Title	Natural Language Processing Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None/if any			

Learning Objective:

The ultimate goal of NLP is to help computers understand language as well as we does. It is the

driving force behind things like virtual assistants, speech recognition, sentiment analysis, automatic text summarization, machine translation and much more.

Course Outcomes

At the end of the course, the student will be able to:

CO1: Use the NLTK and spaCy toolkit for NLP Programming.

CO2: Analyze various corpora for developing programs.

CO3: Develop various pre-processing techniques for a given corpus.

CO4: Develop programming logic using NLTK functions.

CO5: Build applications using various NLP techniques for a given corpus.

Course Contents:

List of Programs

1. Installation and exploring features of NLTK and spaCy tools. Download WordCloud and a few corpora.
2. (i) Write a program to implement word Tokenizer, Sentence, and Paragraph Tokenizers. (ii) Check how many words are there in any corpus. Also, check how many distinct words are there?
3. (i) Write a program to implement both user-defined and pre-defined functions to generate (a) Uni-grams (b) Bi-grams (c) Tri-grams (d) N-grams (ii) Write a program to calculate the highest probability of a word (w2) occurring after another word (w1).
4. (i) Write a program to identify the word collocations. (ii) Write a program to print all words beginning with a given sequence of letters. (iii) Write a program to print all words longer than four characters.
5. (i) Write a program to identify the mathematical expression in a given sentence. (ii) Write a program to identify different components of an email address.
6. (i) Write a program to identify all antonyms and synonyms of a word. (ii) Write a program to find hyponymy, homonymy, polysemy for a given word.
7. (i) Write a program to find all the stopwords in any given text. (ii) Write a function that finds the 50 most frequently occurring words of a text that are not stopwords.
8. Write a program to implement various stemming techniques and prepare a chart with the performance of each method.

CO-PO Mapping:

Course Outcome (CO)	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	PSO -3
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Course Outcome (CO)	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	PSO -3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS6201			
Course Title	Innovation, Entrepreneurship & IPR			
Category	MC, Mandatory Course			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None/if any			

Learning Objective:

IPR safeguards the ideas and innovations of entrepreneurs, ensuring that their original works and inventions are protected from potential infringement and unauthorized use. This protection is crucial for fostering a conducive environment for creativity and innovation.

Course Outcomes:

CO1: Students should be able to demonstrate an understanding of the basic concepts of Intellectual Property Rights (IPR).

CO2: Students should be able to differentiate between Trademarks, Trade Secrets, and Geographical Indications (GI) of goods.

CO3: Students should be able to understand Copyrights, Patents, and Industrial Designs.

CO4: Students should be able to manage and protect IP.

CO5: Students will gain knowledge on Cyberlaw.

Module 1: Introduction to Intellectual Property Rights

- Introduction to Intellectual Property Rights
- Types of intellectual property
- Importance of intellectual property rights

- Evolution of IP acts and treaties
- Agencies responsible for IPR registrations
- Role and value of IP in international commerce
- Issues affecting IP internationally

Module 2: Trade Marks, Trade Secrets, and Geographical Indication of Goods

- Purpose and function of trademarks
- Acquisition of trade mark rights
- Transfer of rights
- Selecting and evaluating trademarks
- Registration of trademarks
- Claims
- Trade secret law
- Determination of trade secret status
- Liability for misappropriation of trade secrets
- Trade secret litigation
- Basic aspects and need for the registration of Geographical Indication of Goods

Module 3: Copyrights, Patents, and Industrial Designs

- Fundamentals of copyright law
- Originality of material
- Right of reproduction
- Right to perform the work publicly
- Copyright ownership issues
- Notice of copyright
- Foundation of patent law
- Patent searching process
- Basic criteria of patentability
- Kind of protection provided in Industrial design

Module 4: Managing IP Rights

- Acquiring IP Rights: letters of instruction, joint collaboration agreement
- Protecting IP Rights: non-disclosure agreement, cease and desist letter, settlement memorandum
- Transferring IP Rights: Assignment contract, license agreement, deed of assignment

Module 5: Introduction to Cyberlaw

- Information Technology Act
- Cybercrime and e-commerce
- Data security, confidentiality, privacy
- International aspects of computer and online crime

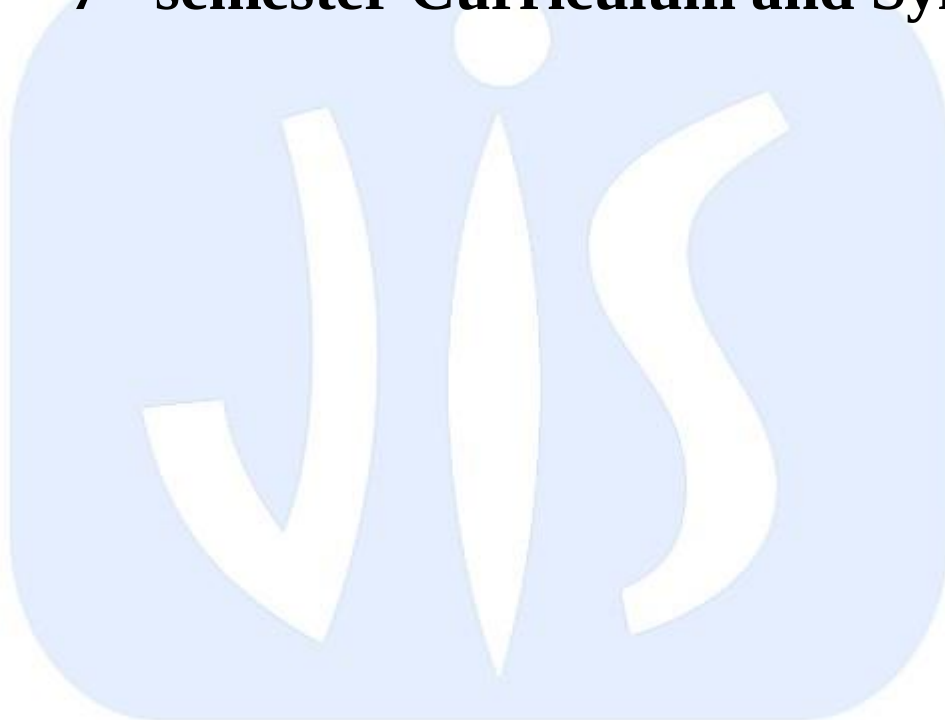
Text/ References Books:

1. "Intellectual Property Rights" by Deborah E. Bouchoux
2. "Cyberlaw, Text and Cases" by Southwestern Special Topics Collection
3. "Intellectual Property Rights" by N. K. Acharya
4. "Fundamentals of IPR for Engineers" by Komal Bansal
5. "Intellectual Property Rights" by P. Radhakrishnan

CO-PO Mapping:

Course Outcome (CO)	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
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

7th semester Curriculum and Syllabus



UNIVERSITY

Course Code	YCS7002C			
Course Title	Web Technology			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

The primary professional objective of a web developer is to write code to make a website. They must employ various programming techniques and tools to deliver high-quality results. Web technology refers to the means by which computers communicate with each other using markup languages and multimedia packages. It gives us a way to interact with hosted information, like websites

Course Outcome:

CO1: Design and develop web applications.

CO2: Explain client and server-side scripting and their applicability.

CO3: Create scripts using JavaScript in a web page

CO4: Integrate JavaScript in a web page.

CO5: Design forms and check for data accuracy.

Course Content:

Module 1:

[7L]

Web Basics and Overview: Introduction to Internet, World Wide Web, Web Browsers, URL, MIME, HTTP, Web Programmers Toolbox. HTML Common tags: List, Tables, images, forms, frames, Cascading Style Sheets (CSS) & its Types. Introduction to Java Script, Declaring variables, functions, Event handlers (onclick, onsubmit, etc.,) and Form Validation.

Module 2:

[6L]

Introduction to XML: Document type definition, XML Schemas, Presenting XML , Introduction to XHTML, Using XML Processors: DOM and SAX. PHP: Declaring Variables, Data types, Operators, Control structures, Functions.

Module 3:

[6L]

Web Servers and Servlets: Introduction to Servlets, Lifecycle of a Servlet, JSDK, Deploying Servlet, The Servlet API, The javax. Servlet Package, Reading Servlet parameters, Reading Initialization parameters. The javax.servlet HTTP package, Handling Http Request & Responses, Cookies and Session Tracking..

Module 4:**[7L]**

Database Access: Database Programming using JDBC, JDBC drivers, Studying Javax.sql.* package, Connecting to database in PHP, Execute Simple Queries, Accessing a Database from a Servlet. Introduction to struts frameworks.

Module 4:**[10L]**

JSP Application Development: The Anatomy of a JSP Page, JSP Processing. JSP Application Design and JSP Environment, JSP Declarations, Directives, Expressions, Scripting Elements, implicit objects. Java Beans: Introduction to Beans, Deploying java Beans in a JSP page

Text/Reference Books:

1. Programming world wide web-Sebesta, Pearson Education,2007.
2. Internet and World Wide Web – How to program by Dietel and Nieto PHI/ Pearson EducationAsia.
3. Jakarta Struts Cookbook, Bill Siggelkow, S P D O' Reilly for chap8.
4. March's beginning JAVA JDK 5, Murach,SPD
5. An Introduction to WEB Design and Programming –Wang-Thomson
6. PHP: The Complete Reference Steven Holzner TataMcGraw-Hill.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7002A			
Course Title	Computer Vision			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To introduce students the fundamentals of image formation; To introduce students the major ideas,

methods, and techniques of computer vision and pattern recognition; To develop an appreciation for various issues in the design of computer vision and object recognition systems; and To provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcome:

- CO1:** To identify basic concepts, terminology, theories, models and methods in the field of computer vision,
- CO2:** To describe known principles of human visual system,
- CO3:** To describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition,
- CO4:** To suggest a design of a computer vision system for a specific problem
- CO5:** To apply computer vision techniques to solve real-world problems, such as image classification, object detection, and image segmentation.

Course Content:

Module 1: [10L]

Introduction, Image Formation – geometric primitives and transformations, photometric image formation, digital camera, Image Processing – point operators, linear filtering, neighborhood operators, Fourier transforms, and segmentation.

Module 2: [12L]

Feature Detection and Matching – points and patches, edges, lines, Feature-based Alignment – 2D, 3D feature-based alignment, pose estimation, Image Stitching, Dense motion estimation – Optical flow – layered motion, parametric motion, Structure from Motion.

Module 3: [14L]

Recognition – object detection, face recognition, instance recognition, category recognition, Stereo Correspondence – Epipolar geometry, correspondence, 3D reconstruction.

Text/Reference Books:

1. zeliski R., “Computer Vision: Algorithms and Applications”, Springer, 2010.
2. Shapiro L. G. and Stockman G., “Computer Vision”, Prentice Hall, 2001.
3. Forsyth D. A. and Ponce J., “Computer Vision – A Modern Approach”, Second Edition, Pearson Education, 2012.
4. Davies E. R., “Machine Vision: Theory, Algorithms, Practicalities”, Morgan Kaufmann, 2004.
5. Jain R., Kasturi R. and Shunck B. G., “Machine Vision”, McGraw Hill, 1995.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7002B			
Course Title	Parallel Computing			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To learn the advanced concepts of Parallel and Distributed Computing and its implementation for assessment of understanding the course by the students

Course Outcome:

- CO1:** Understand implicit and explicit parallel platform
- CO2:** Decompose given problem into many sub problems using different decomposition techniques
- CO3:** Use different performance metrics for analysis of parallel algorithms
- CO4:** Use message passing library for communication among process running on parallel platform
- CO5:** Develop parallel algorithms for shared address space platform using multithreading

Course Content:

Module 1:

[6L]

Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.

Module 2:**[6L]**

Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models

Module 3:**[8L]**

Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, all to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations

Module 4:**[6L]**

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity and Data Mapping on Performance, Amdahl's law, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.

Module 5:**[10L]**

Programming Using the Message Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Collective Communication and Computation Operations, Groups and Communicators. Programming Shared Address Space Platforms Thread Basics: Why Threads? The POSIX Thread Application Programme Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Synchronization Constructs, OPEN MP . Applications: Cancellation, Composite Parallel algorithm development for Matrix multiplication, Sorting and Graph

Text/Reference Books:

1. A Grama, AGupra, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley,2003.
2. C Lin, L Snyder. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company,2008.
3. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming.Morgan Kaufmann Publishing and Elsevier,2013.
4. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison-Wesley Professional

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7002C				
Course Title	Neural Networks and Deep Learning				
Category	ENGG, Major				
LTP & Credits	L	T	P	Credits	
	3	1	0	4	
Total Contact Hours	48				
Pre-requisites					

Learning Objective:

Neural networks can help computers make intelligent decisions with limited human assistance. This is because they can learn and model the relationships between input and output data that are nonlinear and complex. Deep learning covers the theory and practice of a big family of very effective techniques today in the domain of machine learning. The objective of the course is to enable students to get familiarity with this area and to gain adequate knowledge to apply the techniques in solving real world problems.

Course Outcome:

- CO1:** Able to understand the mathematics behind functioning of artificial neural networks
- CO2:** Able to analyze the given dataset for designing a neural network based solution
- CO3:** Able to carry out design and implementation of deep learning models for signal/image processing applications
- CO4:** Able to design and deploy simple TensorFlow-based deep learning solutions to classification problems
- CO5:** Able to apply deep learning techniques to solve real-world problems, demonstrating an understanding of the practical applications of neural networks.

Course Content:

Module 1: [6L]

Introduction: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

Module 2: [8L]

Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network. Cardinality, operations, and properties of fuzzy relations.

Module 3: [8L]

Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and optimization.

Module 4:**[10L]**

Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.

Module 5:**[8L]**

Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.

Module 6:**[8L]**

Deep Learning research: Object recognition, sparse coding, computer vision, natural language

Text/Reference Books:

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
6. Rajiv Chopra, Deep Learning, Khanna Publishing House, 2018.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7003A			
Course Title	Information Retrieval and Data Mining			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

This course is to develop Analyze various data warehousing techniques used in industry. Applying different indexing techniques on real data set and demonstrate different classification methods on real and synthetic data set. Discover knowledge using various Data Mining methods for any system/application.

Course Outcome:

- CO1:** Understanding the basics of Information Retrieval
- CO2:** Realize the data structures like Inverted Indices used in Information retrieval systems.
- CO3:** Realize the concepts of agile methods and software testing.
- CO4:** Learn the different techniques for compression of an index including the dictionary and its posting list.
- CO5:** Developing the ability of develop a complete IR system from Scratch.

Course Content:

- Module 1:** [6L]
Introduction to Information Retrieval and Data Mining include Correlation, Association Rules, Knowledge Discovery from Databases, Classification, and Clustering
- Module 2:** [6L]
Indexing Basic concepts of Indexing. Principles theory of Indexing. Content Analysis: Meaning, Purpose, Applications in real life. Characteristics of Indexing, Languages used for Indexing, Types of Indexing, Criteria for evaluation of Information Retrieval Systems.
- Module 3:** [6L]
Retrieval methods Types of Information retrieval. Search processes, Strategies of Search methods, Boolean Logic, Query Preparation.
- Module 4:** [6L]
Data warehousing What is OLAP, Dimensional Modeling (facts, dimensions), Cube, Schema, defining Schema's Star Schema, Snow-flakes Schema and Fact Constellation, ETL Process
- Module 5:** [6L]
Classification methods Decision tree(ID3,C4.5,CART), Bayesian Classification, Rule based, Neural Network, Lazy and Eager Learners, Performance Parameters of classification algorithms.
- Module 6:** [6L]
Prediction methods Linear and nonlinear regression, Logistic Regression Use of open source data mining tool – WEKA, XL Miner , MOA

Text/Reference Books:

1. "Introduction to information retrieval", Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schutze, Cambridge University Press. 2008
2. J. Han ,M kamber , "Data mining concepts and techniques", Morgan Kaufmann.
3. M . Dunham "Data Mining : Introductory and Advance Topics" Pearson Education.
4. "F. Wilfrid Lancaster. Information retrieval systems: Characteristics, testing and evaluation. 2nd ed. New York: Wiley, 1979.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7003B			
Course Title	Soft Computing			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

The main objective of the course is to expose the students to soft computing, various types of soft computing techniques, and applications of soft computing. Upon completion of this course, the student should be able to get an idea on: Artificial Intelligence, Various types of production systems, characteristics of production systems. Neural Networks, architecture, functions and various algorithms involved. Fuzzy Logic, Various fuzzy systems and their functions. Genetic algorithms, its applications and advances.

Course Outcome:

At the end of the course the student should be able to

- CO1:** To learn about soft computing techniques and their applications
- CO2:** To analyze various neural network architectures
- CO3:** To understand perceptron and counter propagation networks
- CO4:** To Define the fuzzy systems
- CO5:** To analyze the genetic algorithms and their applications

Course Content:

Module 1: Introduction

[6L]

- Introduction to soft computing
- Introduction to fuzzy sets and fuzzy logic systems
- Introduction to biological and artificial neural networks
- Introduction to Genetic Algorithm

Module 2 : Fuzzy Sets and Fuzzy Logic Systems

[9L]

- Classical Sets and Fuzzy Sets and Fuzzy relations
- Operations on Classical sets, properties of classical sets
- Fuzzy set operations, properties of fuzzy sets, cardinality
- Membership functions, standard forms, boundaries, fuzzification methods
- Fuzzy to Crisp conversions, Lambda Cuts, Defuzzification methods
- Classical Logic and Fuzzy Logic, Approximate reasoning, Fuzzy Implication
- Fuzzy Rule based Systems, Linguistic Hedges, Fuzzy Rule based system, Fuzzy Inference System, Mamdani Fuzzy Models, Sugeno Fuzzy Models
- Applications of Fuzzy Logic in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems, Weather forecasting

Module 3: Neural Network

[9L]

- Introduction to Neural Networks
- Biological Neurons and Artificial neural network
- Model of artificial neuron
- Learning Methods: Hebbian, competitive, Boltzmann etc.
- Neural Network models: Perceptron, Adaline, Madeline networks, single layer network
- Back propagation and multi-layer networks
- Competitive learning networks: Kohonen self-organizing networks, Hebbian learning, Hopfield Networks
- Neuro-Fuzzy modeling
- Applications of Neural Networks in Pattern Recognition and classification

Module 4 : Genetic Algorithms

[7L]

- Simple GA, crossover, mutation
- Multi-objective Genetic Algorithm (MOGA)
- Applications of Genetic Algorithm in search and optimization, GA based clustering Algorithm, Image processing, pattern Recognition

Module 5: Other Soft Computing techniques

[5L]

- Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO)

Text/Reference Books:

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
3. Principles of Soft Computing, S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
6. Neural Networks: A Classroom Approach, 1/e by Kumar Satish, TMH,

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO- 1	PSO- 2	PSO- 3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7003C				
Course Title	Software Engineering				
Category	Major ENGG				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites					

Learning Objective:

The students will be able to comprehend the various software process models. To understand the types of software requirements and SRS document. To know the different software design and architectural styles. To learn the software testing approaches and metrics used in software development. To know about quality control and risk management.

Course Outcome:

- CO1:** To compare and select a process model for a business system.
- CO2:** To identify and specify the requirements for the development of an application.
- CO3:** To develop and maintain efficient, reliable and cost effective software solutions.
- CO4:** To critically think and evaluate assumptions and arguments of the client.
- CO5:** To understand the importance of software maintenance and the techniques involved in maintaining software systems.

Course Content:

Module 1:

[9L]

Introduction to Software Engineering: The evolving role of software, Changing Nature of Software, Software myths. A Generic view of process: Software engineering- A layered technology, a process framework, Process patterns, process assessment. Process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process, Agility and Agile Process model, Extreme Programming, Other process models of Agile Development and Tools

Module 2:**[8L]**

Software Requirements: Functional and non-functional requirements, User requirements, System requirements, Interface specification, the software requirements document. Requirements Engineering process: Feasibility studies, Requirements elicitation and analysis, Requirements validation, Requirements management. System models: Context Models, Behavioral models, Data models, Object models, structured methods. UML Diagrams.

Module 3:**[7L]**

Design Engineering: Design process and Design quality, Design concepts, the design model. Creating an architectural design: Software architecture, Data design, Architectural styles and patterns, Architectural Design. Object-Oriented Design: Objects and object classes, An Object-Oriented design process, Design evolution. Performing User interface design: Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation

Module 4:**[6L]**

Testing Strategies: A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging. Product metrics: Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance. Metrics for Process and Projects: Software Measurement, Metrics for software quality.

Module 5:**[6L]**

Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan. Quality Management: Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, The Capability Maturity Model Integration (CMMI), Software reliability, The ISO 9000 quality standards.

Text/Reference Books:

1. Software Engineering A practitioner's Approach, Roger S Pressman, 6th edition. McGraw Hill International Edition.
2. Software Engineering, Ian Sommerville, 7th edition, Pearson education.
3. Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India, 2010.
4. Software Engineering: A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008
5. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.
6. Software Engineering1: Abstraction and modelling, Diner Bjorner, Springer International edition, 2006.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7004A				
Course Title	Wireless Sensor Network and IoT				
Category	ENGG,Minor				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Hours	Contact	36			
Pre-requisites					

Learning Objective:

To understand the characteristics, basic concepts in Wireless sensor networks. To understand the architecture framework and goals of WSN. To understand the Medium Access control and its protocols. To understand the routing metrics and network layer protocols. To understand the QoS based routing protocols

Course Outcome:

- CO1:** Understand the challenges, design goals and architecture of Wireless sensor networks
- CO2:** Understand the channel encoding and modulation mechanism.
- CO3:** Understand the contention free and contention based MAC protocols
- CO4:** Understand the routing metrics and protocols of Network layer
- CO5:** Understand the QoS based routing protocols

Course Content:

Module 1: [5L]

Introduction: Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture.

Module 2: [5L]

Basic Architectural Frame-work:-Physical Layer, Basic Components, Source Encoding, Channel Encoding, Modulation. Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Module 3: [5L]

Medium Access Control: : Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC. Protocols, Contention-Based MAC Protocols, and Hybrid MAC Protocols. Location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

Module 4: [4L]

Network Layer: Routing Metrics, Flooding and Gossiping, Data Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing.

Module 5: [4L]

QoS-Based Routing Protocols: Node and Network Management: Power Management, Local Power Management aspects, Dynamic Power Management, Conceptual Architecture

Module 6: [6L]

IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT,M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT,XMPP) for IoT/M2M devices.

Module 7: [7L]

Architecture and Design Principles for IoT: Internet connectivity, Internet based communication, IPv4, IPv6, 6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports.

Data Collection, Storage and Computing using a Cloud Platform: Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits.

Text/Reference Books:

1. Raj Kamal, "Internet of Things-Architecture and design principles", McGraw Hill Education.
2. 2 Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
4. 2 Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols and Applications", John Wiley, 2007.
5. Anna Hac, 'Wireless Sensor Network Designs", John Wiley, 2003.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7004B				
Course Title	Information and Coding Theory				
Category	ENGG,Minor				
LTP & Credits	L	T	P	Credits	
	3	0	0	3	
Total Contact Hours	36				
Pre-requisites					

Learning Objective:

To develop an understanding of modern network architectures from a design and performance perspective. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs). To provide an opportunity to do network programming

Course Outcome:

CO1: To Perform information theoretic analysis of communication system.

CO2: To Design a data compression scheme using suitable source coding technique.

CO3: To Design a channel coding scheme for a communication system.

CO4: To Understand and apply fundamental principles of data communication and networking.

CO5: To apply flow and error control techniques in communication networks.

Course Content:**Module 1:****[5L]**

Source Coding Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes

Module 2:**[6L]**

Channel Capacity And Coding [7L] Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit

Module 3: [6L]

Linear And Block Codes For Error Correction [8L] Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes

Module 4: [5L]

Cyclic Codes Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes..

Module 5: [6L]

BCH Codes Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.

Module 6: [8L]

Convolutional Codes Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding

Text/Reference Books:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall.
5. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7004C			
Course Title	Data Science			
Category	ENGG, Minor			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To provide fundamental knowledge on data science with querying and analytics required for the field of data science. To understand the process of handling heterogeneous data, pre-process and visualize them for better understanding. This will gain the fundamental knowledge on data science tools and gain basic skill set to solve real-time data science problems.

Course Outcome:

Upon completion of the course the student will be able to

CO1: Ability to obtain fundamental knowledge on data science

CO2: Demonstrate proficiency in data analytics.

CO3: Apply advanced tools to work on dimensionality reduction and mathematical operations

CO4: Handle various types of data and visualize them using through programming for knowledge representation

CO5: Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.

Course Content:

Module 1: [2L]

Need for Data Science – What is Data Science - Data Science Process – Business Intelligence and Data Science – Prerequisites for a Data Scientist – Tools and Skills required

Module 2: [5L]

Structured Query Language (SQL): Basic Statistics, Data Munging, Filtering, Joins, Aggregation, Window Functions, Ordered Data, preparing No-SQL: Document Databases, Wide-column Databases and Graphical Databases.

Module 3: [4L]

Analytics for Data Science – Examples of Data Analytics – Data Analytics Lifecycle: Data Discovery, Data Preparation, Model Planning, Model Building, Communicate Results.

Module 4: [8L]

Major Text Mining Areas – Information Retrieval – Data Mining – Natural Language Processing (NLP) – Text analytics tasks: Cleaning and Parsing, Searching, Retrieval, Text Mining, Part-of-Speech Tagging, Stemming, Text Analytics Pipeline. NLP: Major components of NLP, stages of NLP, and NLP applications.

Module 5:

[6L]

Python for Data Science –Python Libraries – Data Frame Manipulation with numpy and pandas – Exploration Data Analysis – Time Series Dataset – Clustering with Python – Dimensionality Reduction. Python integrated Development Environments (IDE) for Data Science.

Module 6:

[5L]

Handling Vectors and Matrices: Multiplication, Transpose, Random Matrix creation, Eigen Vectors and Eigen Values, Determinants. Arithmetic Operations – Set Operations – Plotting Data

Module 7:

[4L]

Tableau Introduction – Dimensions, Measures, Descriptive Statistics, Basic Charts, Dashboard Design Principles, Special Chart Types, Integrate Tableau with Google Sheets

Module 8:

[2L]

Contemporary Issues

Text/Reference Books:

1. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, 'Fundamentals of Data Science, CRC Press, 1st Edition, 2022.
2. Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge University Press, First Edition, 2020.
3. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 1st Edition, 2015.
4. Ani Adhikari and John DeNero, 'Computational and Inferential Thinking: The Foundations of Data Science', GitBook, 2019.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YBB7001			
Course Title	Human Resource Development and Organizational Behavior			
Category	HUM, Minor			
LTP & Credits	L	T	P	Credits
	2	0	0	1
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To provide an understanding of the basic principles of organizational behaviour so as to acquaint the students with managerial skills and the required inputs with reference to human resource management.

Course Outcome:

- CO1:** To define and explain the basic concepts of organizational behaviour and motivation.
- CO2:** To explain the essential concepts of organizational conflicts, resolution of conflicts through negotiation, change management and organizational development.
- CO3:** To familiarize the various aspects of HR, to deal effectively with people resourcing and talent management and HR functions in an organization.
- CO4:** To understand the concepts of HRD, its role and importance in the success of organization
- CO5:** To develop an understanding towards compensation management and industrial relations

Course Content:

Module 1:

[8L]

Introduction to Organizational Behavior : Meaning and scope of organizational behavior - Challenges and Opportunities – Foundations of Individual behavior, Motivation - Theories (Maslow, ERG, Douglas McGregor two-factor theory), Group dynamics, Leaderships styles

Module 2:

[7L]

Organizational Conflict - causes and consequences - conflict and negotiation, Organizational change, change management process, resistance to change, flexibility and crisis management – Organisational Development – concept and significance

Module 3:

[6L]

HRM: Meaning, definition and functions. Job Analysis, Job Design, Human Resource Planning - Recruitment and Selection - Sources of Recruitment - Selection process, Placement and Induction

Module 4:

[7L]

Introduction to Human Resource Development: Concepts - Training and Development - methods of training, importance of Performance Appraisal, traditional and modern methods of performance appraisal, Job Evaluation - methods of Job Evaluation, Wage and Salary Administration

Module 5:

[8L]

Compensation – Concepts and Principles, Influencing Factors, Emerging Trends in Compensation – Methods of Payment – Incentives and Rewards, Managing Industrial Relations – Emerging trends and practices in human resource management

Text/Reference Books:

1. K. Aswathappa, Organizational Behaviour, 12th edition, Himalaya, 2016
2. Edwin B. Flippo, Personnel Management, 6th edition, TMH, 2013
3. P. Subba Rao, Management & Organizational Behavior, 2nd edition, Himalaya, 2014
4. C.B. Mamoria & VSP Rao, Personnel Management, 20th edition, Himalaya, 2015
5. Stephen P. Robins, Organisational Behaviour, 11th edition, PHI Learning / Pearson Education, 2008

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7101			
Course Title	Web Technology Laboratory			
Category	Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

This course is intended to teach the basics involved in publishing content on the World Wide Web. This includes the 'language of the Web'—HTML, the fundamentals of how the Internet and the Web

function, a basic understanding of graphic production with a specific stress on creating graphics for the Web, and a general grounding introduction to more advanced topics such as programming and scripting. This will also expose students to the basic tools and applications used in Web publishing.

Course Outcome:

The students will be able to:

- CO1:** Analyze a web page and identify its elements and attributes.
- CO2:** Create web pages using XHTML and Cascading Style Sheets.
- CO3:** Build dynamic web pages using Java Script (Client side programming).
- CO4:** Create XML documents and Schemas.
- CO5:** Understand the basic concepts and principles of web security, including common vulnerabilities and best practices for securing web applications and data transmission.

Course Content:

List of Experiments:

1. HTML Table Creation:
 - Create an HTML table with the following details:
 - Book Name
 - Author
 - Operating Systems - Godbole
 - Data Communications and Networks - Godbole
 - Computer Networks - Rajkumar
 - OOPs - R.NageswaraRao
2. Form Creation with Input Attributes:
 - Create an HTML form with various attributes for input tags.
3. Multiple Stylesheets in a Single Page:
 - Create a web page that uses multiple types of stylesheets.
4. CGI Sample Program:
 - Write a CGI program to send output back to the user.
5. JavaScript Program with Variables:
 - Write a JavaScript program using variables.
6. JavaScript Program for Multiplication:
 - Write a JavaScript program to multiply two numbers and display the result in a separate text box.
7. JavaScript Program for Form Validation:
 - Write a JavaScript program for form validations.
8. AJAX Program for XML Http Request:
 - Write an AJAX program to check the presence of the XML Http Request object.
9. AJAX Program for Sales Report:
 - Write a program to create a sales report for books using AJAX.
10. XML Document Template for Student Results:
 - Create an XML document template to describe the results of students in an examination. Include the student's roll number, name, three subject names and marks, total marks, percentage, and results.
11. XSLT Code for Book Titles and Prices:
 - Write XSLT code to retrieve only the book titles and their prices.
12. Homepage Design:

- Design basic elements of a homepage.

Text/Reference Books:

- Achyut Godbole, Atul Kahate, "Web Technologies: TCP/IP, Web/Java Programming, and Cloud Computing", Third Edition, McGraw-Hill Education.
- Deitel, Deitel, Goldberg, "Internet & World Wide Web How to Program", Third Edition, Pearson Education, 2006.
- Raj Kamal, "Internet and Web Technologies", Tata McGraw-Hill.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7102A				
Course Title	Computer Vision Laboratory				
Category	Major				
LTP & Credits	L	T	P	Credits	
	0	0	3	1.5	
Total Contact Hours	36				
Pre-requisites					

Learning Objective:

Identify, formulate, and solve problems in computer vision. Evaluate computer vision systems by applying theories and methods used in the field. Design and develop innovative computer vision applications or systems.

Course Outcome:

After completing the course you will be able to

- CO1:** To identify basic concepts, terminology, theories, models and methods in the field of computer vision.
- CO2:** To describe known principles of human visual system.
- CO3:** To describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition
- CO4:** To suggest a design of a computer vision system for a specific problem.
- CO5:** To apply advanced techniques such as deep learning models, convolutional

neural networks, and feature extraction methods in computer vision tasks.

Course Content:

List of Experiments:

1. Introduction to python programming.
2. Write a program to display the negative of a digital image.
3. Write a program to perform thresholding on a digital image.
4. Write a program to perform gray level slicing without background
5. Perform basic Image Handling and Processing operations on the image.
6. Geometric Transformation.
7. Compute Homography Matrix
8. Perspective Transformation
9. Camera Calibration
10. Compute Fundamental Matrix
11. Edge Detection, Line Detection and, Corner Detection
12. SIFT Feature descriptor
13. SURF and HOG feature descriptor
14. Project based on Computer Vision Applications

Requirements: install the Anaconda, Spyder (Scientific Python Development Environment) IDE for Computer Vision Lab.

Text/Reference Books:

1. Rafael.C,Gonzalez, Richard E Woods, “Digital Image Processing”,3rdEdition, Pearson India, 2013.
2. Jain A.K, “Fundamentals of Digital Image Processing”, 4th Edition, Prentice hall of India, 2004
3. B.Chanda, D. DuttaMajumder, “Digital Image Processing and Analysis”, 2ndEdition, Phi learning, 2011.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7102B			
Course Title	Parallel Computing Laboratory			
Category	Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

Parallel programming is ubiquitous in today's multi-core era and solves many real-world scientific problems. Massive parallelism entails significant hardware and software challenges. The course is structured so that the participants understand challenges in efficient execution of large-scale parallel applications. The assignments will be designed to strengthen understanding of parallel programming. The course will also involve a research-based project component.

Course Outcome:

At the end of this course student will:

- CO1:** To solve the problems in parallel
- CO2:** To have knowledge on different structures of parallel computers
- CO3:** To understand the performance evaluation of parallel computers
- CO4:** To get acquaintance on CUDA
- CO5:** To develop parallel programs in CUDA C

Course Content:

List of Experiments:

1. a) Implement Parallel Reduction using Min, Max, Sum and Average operations.
2. b) Write a CUDA program that, given an N-element vector, find-
 - i. The maximum element in the vector
 - ii. The minimum element in the vector
 - iii. The arithmetic mean of the vector
 - iv. The standard deviation of the values in the vector
3. Vector and Matrix Operations-
 - a. Design parallel algorithm to
 - b. Add two large vectors
 - c. Multiply Vector and Matrix
 - d. Multiply two $N \times N$ arrays using n^2 processors
4. Message passing and Message matching in MPI
5. Broadcast and reduction in MPI
6. Working with MPI derived types
7. Pthreads- synchronization using mutex and busy waiting
8. Pthreads- synchronization using semaphores- Producer Consumer problem

9. Pthreads-thread synchronization using barriers and condition variables
10. Implementation of concurrent List with Pthread read write locks
11. Reduction clause in OpenMP
12. Program using parallel for directive in OpenMP
13. Scheduling loops in OpenMP – Odd even transposition sort
14. Synchronization in OpenMP - Producer Consumer problem
15. Working with OpenCL buffers and image object

Text/Reference Books:

1. Peter S. Pacheco, “An introduction to parallel programming”, Morgan Kaufmann, 2011. 2
- A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, “OpenCL programming guide”, Addison Wesley, 2011
3. M. J. Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
4. W. Gropp, E. Lusk, and R. Thakur, “Using MPI-2: Advanced features of the message passing interface”, MIT Press, 1999.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS7102C			
Course Title	Neural Networks and Deep Learning Laboratory			
Category	ENGG, Major			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To build the Foundation of Deep Learning and understand how to build the neural network. Enable students to develop successful machine learning concepts.

Course Outcome:

- CO1:** To Understand basic neuron models and learning algorithms by using Matlab's neural network toolbox
- CO2:** To Describe about different activation function (transfer function).
- CO3:** To Analyze how weights & bias values affect the output of neuron
- CO4:** To Identify how weights & bias values are able to represent a decision boundary in the feature space
- CO5:** To Conceptualize about perceptron learning rule works for linearly separable problems

Course Content:

List of Experiments:

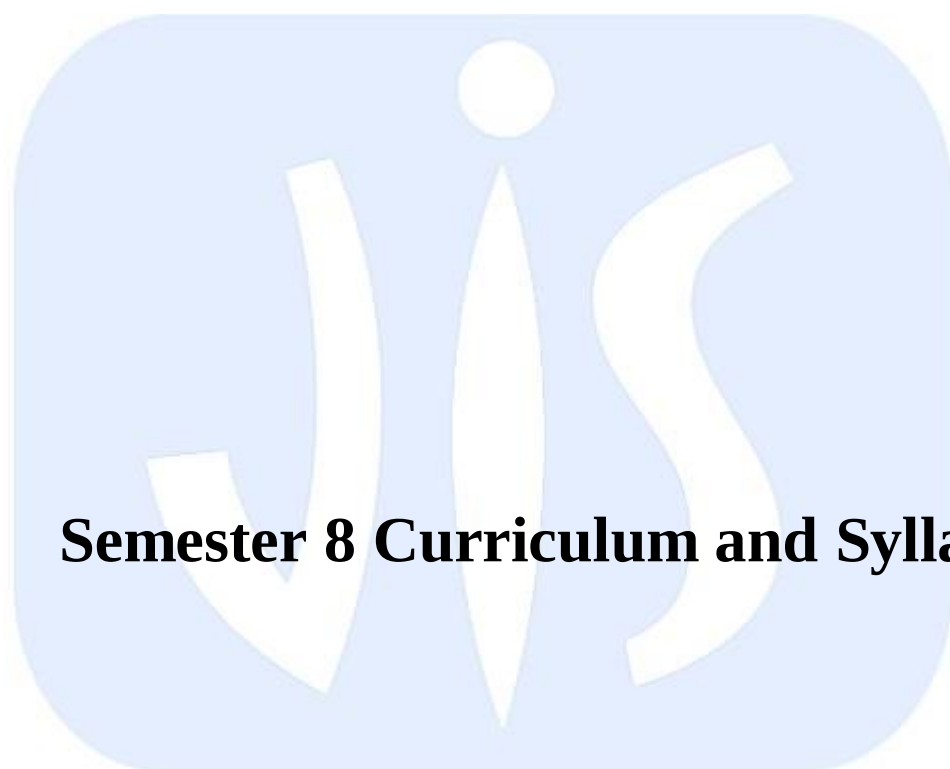
1. To write a program to implement Perception.
2. To write a program to implement AND OR gates using Perception.
3. To implement Crab Classification using pattern net Objective.
4. To write a program to implement Wine Classification using Back propagation
5. Write a MatLab Script containing four functions Addition, Subtraction, Multiply and Divide functions.
6. Write a program to implement classification of linearly separable Data with a perceptron.
7. To study ImageNet, GoogleNet, ResNet convolutional Neural Networks.
8. To study Convolutional Neural Network and Recurrent Neural Network.
9. Write a program to draw a graph with multiple curve.
10. How the weight and biased value are able to represent a decision boundary in the feature space.
11. Write a program to develop Auto encoders using MNIST Handwritten Digits.
12. Write a program to develop a GAN for Generating MNIST Handwritten Digits.

Text/Reference Books:

1. Navin Kumar Manaswi ,Deep Learning with Applications Using Python Chatbots and Face, Object, and Speech Recognition With TensorFlow and Keras , Apress,2018.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press,2016.
3. Josh Patterson and Adam Gibson, "Deep learning: A practitioner's approach", O'Reilly Media, First Edition, 2017.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



Semester 8 Curriculum and Syllabus

UNIVERSITY

Course Code	YCS8001A			
Course Title	Big Data Analytics			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	36			
Pre-requisites	Should have knowledge of one Programming Language (Java preferably), Practice of SQL			

Learning Objective:

Understand the Big Data Platform and its Use cases. Provide an overview of Apache Hadoop Provide HDFS Concepts and Interfacing with HDFS .Understand Map Reduce Jobs. Provide hands on Hadoop Eco System. Apply analytics on Structured, Unstructured Data. Exposure to Data Analytics with R.

Course Outcome:

- CO1:** Identify Big Data and its Business Implications.
- CO2:** List the components of Hadoop and Hadoop Eco-System
- CO3:** Access and Process Data on Distributed File System
- CO4:** Manage Job Execution in Hadoop Environment
- CO5:** Analyze Info sphere Big Insights Big Data Recommendations.

Course Content:

Module 1: [8L]

Introduction To Big Data And Hadoop Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

Module 2: [10L]

HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures

Module 3: [8L]

Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort,

Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Module 4:

[12L]

Hadoop Eco System Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

Module 5:

[10L]

Data Analytics with R Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Text/Reference Books:

1. Tom White “ Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007.
4. Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press (2013)
5. Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media (2013), Oracle press.
6. Anand Rajaraman and Jeffrey David Ulman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
7. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
8. Glen J. Myat, “Making Sense of Data”, John Wiley & Sons, 2007
9. Pete Warden, “Big Data Glossary”, O’Reily, 2011.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS8001B				
Course Title	Block Chain and Crypto Currency Technologies				
Category	Major ENGG				
LTP & Credits	L	T	P	Credits	
	3	1	0	4	
Total Contact Hours	48				
Pre-requisites					

Learning Objective:

The block chain technology course allows the students to explore the driving force behind the crypto currency Bitcoin. Along with the Decentralization, Cryptography, Bitcoins with its alternative coins, Smart contracts and outside of currencies

Course Outcome:

- CO1:** Understand the types, benefits and limitation of block chain.
- CO2:** Explore the block chain decentralization and cryptography concepts
- CO3:** Enumerate the Bitcoin features and its alternative options.
- CO4:** Describe and deploy the smart contracts
- CO5:** Summarize the block chain features outside of currencies

Course Content:

Module 1: [10L]

Blockchain Architecture – Challenges – Applications – Blockchain Design Principles - The Blockchain Ecosystem - The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - peer-to-peer network – Abstract Models - GARAY model - RLA Model - Proof of Work (PoW) - Proof of Stake (PoS) based Chains - Hybrid models

Module 2: [9L]

Origin of Ledgers – Types and Features of Distributed Ledger Technology (DLT) - Role of Consensus Mechanism - DLT Ecosystem - Distributed Ledger Implementations – Blockchain - Ethereum - Public and Private Ledgers – Registries – Ledgers - Practitioner Perspective: Keyless Technologies, Transparency as a Strategic Risk, Transparency as a Strategic Asset, Usage of Multiple IDs - Zero Knowledge Proofs - Implementation of Public and Private Blockchain

Module 3:

[9L]

Anatomy of a Smart Contracts - Life Cycle - Usage Patterns - DLT-based smart contracts - Use Cases: Healthcare Industry and Property Transfer. Decentralization versus Distribution - Centralized-distributed (Ce-Di) organizations - Decentralized-distributed (De-Di) organizations - Decentralized Autonomous Organizations: Aragon, DAOstack, DAOhaus and Colony

Module 4:

[12L]

Crypto currency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects - Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain. Decentralization and Cryptography. Bitcoin and Alternative Coins A: Bitcoin, Transactions, Blockchain, Bitcoin payments B: Alternative Coins, Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash

Module 5:

[8L]

Bitcoin and Cryptocurrency: What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree

Text/Reference Books:

1. Dhillon, V., Metcalf, D., and Hooper, M, Blockchain enabled applications, 2017, 1st Edition, CA: Apress, Berkeley
2. Diedrich, H., Ethereum: Blockchains, digital assets, smart contracts, decentralized autonomous organizations, 2016, 1st Edition, Wildfire publishing, Sydney
3. Wattenhofer, R. P, Distributed Ledger Technology: The Science of the Blockchain (Inverted Forest Publishing), 2017, 2nd Edition, Createspace Independent Pub, Scotts Valley, California, US.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS8001C				
Course Title	Cyber Security				
Category	Major ENGG				
LTP & Credits	L	T	P	Credits	
	3	1	0	4	
Total Contact Hours	48				
Pre-requisites					

Learning Objective:

The main objectives of cyber security are to protect the confidentiality, integrity, and availability of information and systems. These are also known as the CIA triad and form the basis of all security programs

Course Outcome:

- CO1:** To learn cybercrime and cyber law
- CO2:** To understand the cyber attacks and tools for mitigating them
- CO3:** To understand information gathering.
- CO4:** To learn how to detect a cyber attack.
- CO5:** To learn how to prevent a cyber attack

Course Content:

Module 1:

[10L]

Introduction Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

Module 2:**[14L]**

Reconnaissance Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.

Module 3:**[12L]**

Intrusion Detection Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

Module 4:**[12L]**

Intrusion Prevention: Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.

Text/Reference Books:

1. Anand Shinde, “Introduction to Cyber Security Guide to the World of Cyber Security”, Notion Press, 2021 (Unit 1)
2. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publishers, 2011 (Unit 1)
3. David Kim, Michael G. Solomon, “Fundamentals of Information Systems Security”, Jones & Bartlett Learning Publishers, 2013 (Unit 2)

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS8002A			
Course Title	Pattern Recognition			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	3	0	0	4
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

Pattern recognition is a branch of machine learning that focuses on the recognition of patterns and regularities in data, although it is in some cases considered to be nearly synonymous with machine learning. Recently, Machine Learning has gained great importance for the design of search engines, robots, and sensor systems, and for the processing of large scientific data sets.

Course Outcome:

On the successful completion of this course Student are able

CO1: Summarize the various techniques involved in pattern recognition

CO2: Categorize the various pattern recognition techniques into supervised and unsupervised.

CO3: Illustrate the artificial neural network based pattern recognition

CO4: Discuss the applications of pattern recognition in various applications

CO5: Understand the various Graphical Approaches

Course Content:

Module 1:

[7L]

Pattern Recognition Overview : Typical Pattern Recognition System, Patterns and Features Extraction, Training and Learning in Pattern Recognition system, Different types of Pattern Recognition Approaches – Statistical, Syntactic, Neural. Discriminant functions

Module 2:

[7L]

Statistical Pattern Recognition Parametric estimation and supervised learning, Maximum likelihood estimation, Bayesian parameter estimation, Non-parametric approaches - Parzen window, k-NN estimation, Unsupervised Learning – Clustering Concepts.

Module 3:**[8L]**

Syntactic Pattern Recognition : Grammar Based Approaches, Elements of Formal Grammars, Parsing Concepts – Parsing Algorithm, Transition Networks in Parsing, Higher Dimensional Grammars, Stochastic Grammars, Graphical Approaches – Graph Isomorphism, Attributed Graphs

Module 4:**[7L]**

Introduction and historical perspective, Hard and Soft AI– disciplines and applications, Theories of Intelligence, Detecting and Measuring Intelligence, Knowledge based approach, the prepare-deliberate engineering trade-off, Procedural v/s Declarative knowledge, Criticism of symbolic AI, Knowledge representation, desirable properties of KR schemata, Use of predicate calculus in AI.

Module 5:**[7L]**

Expert Systems : Components of Expert Systems, Production rules, Backwards vs Forward reasoning, Statistical reasoning, Meta level knowledge, Introspection, Knowledge engineering case studies, Heuristic search of state space, DFS, BFS, UCS, choice of a search algorithm, Admissibility theorems, search performance metrics, AI programming environments. AI oriented language and architecture

Text/Reference Books:

1. J.I. Tou & R.C. Gonzalez, Pattern Recognition Principles, Addition-Wesley.
2. R. Schalkoff, Pattern Recognition - Statistical, Structural and Neural Approaches, John Wiley, 1992.
3. P.A. Devijer & J. Kittler, Pattern Recognition - A Statistical Approach, Prentice-Hall.
4. Christopher. M. Bishop, 'Pattern recognition and machine learning, Springer, 2006.
5. R.O.Duda, P.E.Hart and D.G.Stork, —Pattern Classification, John Wiley, 2001.
6. Rich, Artificial Intelligence, 2nd ed., , Tata McGraw Hill.
7. R.B. Mishra, Artificial Intelligence, PHI, India, 2010.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS8002B			
Course Title	Bioinformatics			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	3	0	0	4
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To provide a national bio-information network designed to bridge the inter-disciplinary gaps in biotechnology information. b. To establish link among scientists in organizations involved in R & D and manufacturing activities in biotechnology. c. To build up information resources, prepare database on biotechnology and to develop relevant information handling tools and techniques.

Course Outcome:

- CO1:** Infer the biological problems using appropriate in silico approaches
- CO2:** Select the suitable tools or servers to solve the specific biological issue and curate experimental data.
- CO3:** Perform and analyze database and similarity search sequence alignment.
- CO4:** Construct and analyze phylogenetic trees
- CO5:** Use appropriate tools and packages to analyze varied range of biological problems.

Course Content:

Module 1: [5L]

Introduction to strings, edit distance strings, string similarity, elementary commands and protocols, Scope of Bioinformatics.

Module 2: [7L]

Sequence Databases And Their Use Introduction to databases, database search, algorithms issues in database search, sequence database search, parametric sequence alignments, sub optimal alignments, dynamic programming global and local alignment gaps, multiple alignment, common multiple alignment methods. FASTA and BLAST. Amino acid substitution matrices PAM and BLOSSOM.

Module 3:

[6L]

Evolutionary Trees And Phylogeny : Ultrasonic trees, parsimony, ultrametric problem, perfect phylogeny, phylogenetic alignment, connection between multiple alignment and tree constructions.

Module 4:

[7L]

Protein Classification And Structure Visualization : Overview of the protein structure, protein structure visualization, visualization tools and databases, protein structure alignment, protein classification approaches, tools for plotting Protein - ligand interaction.

Module 5:

[6L]

Protein Structure Prediction : Protein identification and characterization, primary structure analysis and prediction, secondary structure analysis and prediction, Ab initio method for protein prediction, protein function prediction.

Module 6:

[5L]

Applications Of Bioinformatics: DNA mapping and sequencing, gene predictions, molecular predictions with DNA strings, role of bioinformatics in drug design

Text/Reference Books:

1. David W. Mount. 2005. Bioinformatics: Sequence and Genome analysis, Cold Spring Harbor Laboratory Press.
2. Jones, N.C. and Pevzner, P. A. 2004. An Introduction to Bioinformatics Algorithms. The MIT Press

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YCS8002C			
Course Title	Robotics			
Category	Major ENGG			
LTP & Credits	L	T	P	Credits
	3	0	0	4
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

To study the kinematics, drive systems and programming of robots. To study the basics of robot laws and transmission systems. To familiarize students with the concepts and techniques of robot manipulator, its kinematics. To familiarize students with the various Programming and Machine Vision application in robots. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

Course Outcome:

CO1: Interpret the features of robots and technology involved in the control
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning..
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

Course Content:

Module 1:

[6L]

Fundamentals Of Robot : Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications..

Module 2:

[8L]

Robot Kinematics Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

Module 3:

[8L]

Robot Drive Systems And End Effectors Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

Module 4:

[7L]

Sensors In Robotics Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

Module 5:

[7L]

Programming And Applications Of Robot Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields

Text/Reference Books:

1. Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.

2. Mikell.P.Groover , “Industrial Robotics – Technology, Programming and applications” McGraw Hill 2ND edition 2012.
3. Fu K.S. Gonalz R.C. and ice C.S.G.”Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill book co. 2007.
4. YoramKoren, “Robotics for Engineers”, McGraw Hill Book, Co., 2002.

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO-1	PSO-2	PSO-3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3

Course Code	YED8501(Non-CGPA)				
Course Title	Essence of Indian Knowledge Tradition				
Category	MC, Mandatory Course				
LTP & Credits	L	T	P	Credits	
	3	0	0	1	
Total Contact Hours	36				
Pre-requisites					

Learning Objective:

To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system

Course Outcome:

- CO1:** Understand the concept of Traditional knowledge and its importance.
CO2: Know the need and importance of protecting traditional knowledge
CO3: Know the various enactments related to the protection of traditional knowledge.
CO4: Understand the concepts of Intellectual property to protect the traditional knowledge.

CO5: Understand the traditional knowledge in different sectors.

Course Content:

Module 1: [8L]

Introduction to traditional knowledge Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge..

Module 2: [6L]

Protection of traditional knowledge The need for protecting traditional knowledge Significance of TK Protection, the value of TK in the global economy, Role of Government to harness TK.

Module 3: [6L]

Legal framework and Traditional Knowledge (10 Lectures) A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003..

Module 4: [8L]

Traditional knowledge and intellectual property Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Module 5: [8L]

Traditional knowledge in different sectors Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Text/Reference Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012. .
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

CO-PO Mapping:

Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO- 1	PSO- 2	PSO- 3
CO1	3	1	1	2	3	2	0	0	3	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3	0	0	0
CO3	1	3	1	2	2	1	0	0	1	0	0	3	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3	0	0	3



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