



Course Directory for

B. Tech. in Computer Science & Business Systems

(Students admitted from 2021–22)

(Total Credits: 180)

Offered by the

SCHOOL OF COMPUTING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO1.** Empower graduates to procure technical and managerial skills for solving real world business problems
- PEO2.** Empower graduates to design and develop innovative decision making systems to solve business problems by applying engineering principles and business strategies
- PEO3.** Enable graduates to create and implement managerial solutions with advanced computing skills addressing industrial and scientific challenges
- PEO4.** Provide broad knowledge base covering different areas in computing and business strategies – from Principles of Electronics to Robotics and Embedded Systems, from Algorithms to Machine Intelligence, from Data Mining & Analysis to Advanced Social, Text & Media Analytics, from Computational Statistics to Computational Finance & Modelling, from Fundamentals of Management to IT Project Management to Marketing Research & Marketing Management
- PEO5.** Equip graduates with capability to design, implement and test computational approaches to develop solutions for the business problems
- PEO6.** Impart independent learning skills to successfully pursue higher studies and engage in innovative research
- PEO7.** Inculcate professional ethics and work with commitment for progress of society

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to

- PO1.** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2.** Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems to reach substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO3.** Design/development of solutions: Design solutions for complex engineering problems and design systems, components or processes that meet the specified needs with appropriate consideration towards public health and safety, and the cultural, societal, and environmental considerations.
- PO4.** Conduct investigations of complex problems: Use research-based knowledge and research methods including statistical tools, analysis, data interpretation, and synthesis of the information to provide valid conclusions.
- PO5.** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

- PO6.** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- PO7.** Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8.** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9.** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10.** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11.** Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12.** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

Upon completion of B.Tech. Computer Science and Business Systems, the graduates will be able to

- PSO1.** Ability to comprehend the problem and apply various programming and managerial skills to develop innovative and quality software products for the changing business needs.
- PSO2.** Ability to provide acceptable technical and managerial solutions for business problems by utilizing the skills of Data Analytics, Cloud Computing and Machine Learning adhering to business standards.
- PSO3.** Ability to serve as an ethical administrator/developer/researcher in the emerging fields of computing and business systems.

**Scheme of Study
I Semester (22 Credits)**

Course Code	Course Title	Periods of Instruction			Credits
		L	T	P	
MAT133	Discrete Mathematics	3	0	0	3
MAT132	Probability & Statistics	3	0	0	3
CSE106	Fundamentals of Computer Science	2	1	0	3
EEE104	Principles of Electrical Engineering	3	0	0	3
PHY137	Fundamentals of Physics	3	0	0	3
ENG136	Business Communication & Value Science – I	2	1	0	3
CSE107	Fundamentals of Computer Science Laboratory	0	0	2	1
EEE105	Principles of Electrical Engineering Laboratory	0	0	2	1
PHY139	Fundamentals of Physics Laboratory	0	0	2	1
ENG137	Business Communication & Value Science – I Laboratory	0	0	2	1
	Induction Program (Non Credit)				0
	Total	16	2	8	22

II Semester (22 Credits)

Course code	Course Title	Periods of Instruction			Credits
		L	T	P	
MAT134	Linear Algebra	3	1	0	4
MAT244	Statistical Modeling	3	1	0	4
CSE209	Data Structures & Algorithms	2	1	0	3
EIE219	Principles of Electronics	3	0	0	3
MGT131	Fundamentals of Economics	2	0	0	2
ENG138	Business Communication & Value Science – II	3	0	0	3
CSE210	Data Structures & Algorithms Laboratory	0	0	2	1
EIE220	Principles of Electronics Laboratory	0	0	2	1
ENG139	Business Communication & Value Science – II Laboratory	0	0	2	1
	Environmental Sciences (Non Credit)				0
	Total	16	3	6	22
4 Weeks – Exchange Program among the Participating Institutes					

III Semester (21 Credits)

Course Code	Course Title	Periods of Instruction			Credits
		L	T	P	
CSE211	Formal Language and Automata Theory	4	1	0	5
CSE212	Computer Organization & Architecture	3	1	0	4
CSE213	Object Oriented Programming	3	0	0	3
CSE214	Computational Statistics	3	0	0	3
INT104	Database Management Systems	3	0	0	3
CSE216	Object Oriented Programming Laboratory	0	0	2	1
CSE217	Computational Statistics Laboratory	0	0	2	1
INT105	Database Management Systems Laboratory	0	0	2	1
	Indian Constitution (Non-credit)				0
	Total	16	2	6	21

IV Semester (23 Credits)

Course Code	Course Title	Periods of Instruction			Credits
		L	T	P	
CSE308	Operating Systems	3	0	0	3
CSE215	Software Engineering	4	0	0	4
CSE318	Algorithm Design Strategies & Analysis	3	0	0	3
MGT207	Introduction to Innovation, IP Management & Entrepreneurship	3	0	0	3
ENG212	Business Communication & Value Science-III	3	0	0	3
MAT330	Operations Research	2	1	0	3
CSE309	Operating Systems Laboratory	0	0	2	1
CSE218	Software Engineering Laboratory	0	0	2	1
CSE319	Algorithm Design Strategies & Analysis Laboratory	0	0	2	1
MS	Operations Research Laboratory	0	0	2	1
	Essence of Indian Traditional Knowledge (Non-credit)				0
	Total	18	1	8	23
4 Weeks - Industry Exposure (Optional)					

V Semester (22 Credits)

Cluster	Course Title	No of Contact Hours / Week			Credits
		L	T	P	
CSE316	Software Design with UML	3	0	0	3
CSE320	Compiler Design	3	0	0	3
MGT132	Fundamentals of Management for Engineers	3	1	0	4
MGT133	Business Strategy	3	0	0	3
ENG315	Design Thinking	2	1	0	3
	Elective - I	3	1	0	4
CSE317	Software Design with UML Laboratory	0	0	2	1
CSE321	Compiler Design (LEX & YACC) Laboratory	0	0	2	1
	Total	17	3	4	22

Departmental Electives

INTXXX	Conversational Systems	3	1	0	4
INT316	Modern Web Applications	3	1	0	4
CSE428	Cloud, Micro services & Application	3	1	0	4

VI Semester (23 Credits)

Cluster	Course Title	No of Contact Hours / Week			Credits
		L	T	P	
CSE322	Computer Networking Principles & Components	3	0	0	3
INT313	Computer System Security	3	1	0	4
INT314	Artificial Intelligence & Logical Reasoning	3	0	0	3
MGTXXX	Financial & Cost Accounting	3	1	0	4
ENG316	Business Communication & Value Science - IV	2	1	0	3
	Elective - II	3	1	0	4
CSE323R01	Computer Networking Principles & Components Laboratory	0	0	2	1
INT315	Artificial Intelligence & Logical Reasoning Laboratory	0	0	2	1
	Total	17	4	4	23
	Industrial Project (6-8 Weeks)				02

Departmental Electives

CSEXXX	Robotics and Embedded Systems	3	1	0	4
CSE415R01	Internet of Things	3	1	0	4
	Behavioral Economics	3	1	0	4

VII Semester (23 Credits)

Course code	Course Title	No of Contact Hours / Week			Credits
		L	T	P	
CSE332	Usability Design of Software Applications	2	0	0	2
INT318	IT Workshop Scilab / Matlab	3	0	0	3
MGT212	Introduction to Financial Management	3	0	0	3
MGT211	Fundamentals of Human Resource Management	3	0	0	3
	Elective - III	3	1	0	4
	Elective - IV	3	1	0	4
CSE333	Usability Design of Software Applications Laboratory	0	0	2	1
INT319	IT Workshop Scilab / Matlab Laboratory	0	0	2	1
	Project Phase - I	0	0	4	2
	Total	17	2	8	23

Departmental Electives

Elective III					
CSE429	Cognitive Science & Analytics	3	1	0	4
CSE425	Machine Learning Essentials	3	1	0	4
CSE430	Cryptology	3	1	0	4
Elective IV					
CSXXX	Quantum Computation & Quantum Information	3	1	0	4
INT317	Data Mining and Analytics	3	1	0	4
ICT404	Mobile Communications	3	1	0	4

VIII Semester (22 Credits)

Cluster	Course Title	No of Contact Hours / Week			Credits
		L	T	P	
	Services Science & Service Operational Management	3	1	0	4
	IT Project Management	2	1	0	3
	Marketing Research & Marketing Management	3	0	0	3
	Elective - V	3	1	0	4
	Elective - VI	3	1	0	4
	Project Phase - II	0	0	8	4
	Total	14	4	8	22

Departmental Electives

Elective V					
DTS	Image Processing and Pattern Recognition	3	1	0	4
MS	Computational Finance & Modeling	3	1	0	4
SH	Industrial Psychology	3	1	0	4
Elective VI					
DTS	Enterprise Systems	3	1	0	4
MS	Advance Finance	3	1	0	4
INT434	Advanced Social, Text and Media Analytics	3	1	0	4

L	T	P	C
3	0	0	3

Course Code: MAT133

Semester: I

DISCRETE MATHEMATICS

Course Objectives:

This course will help the learner to understand Boolean algebra and basic properties of Boolean algebra, understand various concepts in differential, integral and vector calculus and their geometrical interpretations, to learn algebraic structures and concepts in groups and rings and to construct proofs by mathematical induction.

UNIT - I

10 Periods

Boolean algebra: Introduction of Boolean Algebra - Truth Table - Basic Logic Gate - Basic Postulates of Boolean Algebra - Principle of Duality - Canonical Form - Karnaugh Map.

UNIT - II

10 Periods

Calculus: Differential Calculus - Integral Calculus - Applications of Double and Triple Integral.

UNIT - III

15 Periods

Abstract algebra: Set – Relation – Group – Ring - Field.

UNIT - IV

10 Periods

Combinatorics: Basic Counting - Balls and Pins Problems - Generating Functions - Recurrence Relations - Proof Techniques - Principle of Mathematical Induction - Strong form of induction - Pigeonhole Principle.

TEXTBOOKS

1. Herstein I.N. *Topics in Algebra*, John Wiley and Sons, Second Edition, 2006.
2. Morris Mano M. *Digital Logic & Computer Design*, Pearson Education, Tenth Imprint, 2008.
3. Grewal B.S. *Higher Engineering Mathematics*, Khanna Publication, Delhi, Forty Fourth Edition, 2015.

REFERENCES

1. Gilbert Strang, *Introduction to Linear Algebra*, Wellsely-Cambridge Press, Fifth Edition, 2016.
2. Peter V.O'Neil, *Advanced Engineering Mathematics*, Thomson Learning, Seventh Edition, 2012.
3. Greenberg M. D, *Advanced Engineering Mathematics*, Pearson Education, Second Edition, 2002.
4. Wartikar P.N, Wartikar J.N. Textbook of *Applied Mathematics*, Volume I and II, Vidyarthi Prakashan, 2010.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Simplify simple Boolean functions using basic Boolean properties.• Optimize a Boolean expression using Karnaugh Map
Unit II	<ul style="list-style-type: none">• Interpret the geometric meaning of differential and integral calculus• Apply the concept and principles of differential and integral calculus to solve geometric and physical problems
Unit III	<ul style="list-style-type: none">• Understand the basic concepts of group and use appropriate techniques to derive properties of group• Understand the elementary concepts of rings and fields and appreciate the similarities and difference between the these concepts and those of group theory
Unit IV	<ul style="list-style-type: none">• Synthesize induction hypotheses and simple induction proofs• Derive closed form and asymptotic expressions from series and recurrences for growth rates of processes

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Define basic properties of Boolean algebra
- Describe concepts and principles of differential and integral calculus of real functions
- Explain concepts of group, rings and their applications in both algebraic and geometric contexts
- Model and analyze computational processes using combinatorial methods

L	T	P	C
3	0	0	3

Course Code: MAT132**Semester: I**

PROBABILITY AND STATISTICS

Course Objectives:

This course will help the learner to study the key concepts in Probability, Statistical Distributions, correlation and Regression analysis and various sampling techniques so as to understand Engineering subjects such as statistical theory of communication, machine learning techniques etc.

UNIT - I

15 Periods

Probability: Concept of experiments - Sample space - Event - Definition of combinatorial Probability - Conditional Probability - Bayes Theorem

Probability distributions: Discrete & continuous distributions - Binomial, Poisson and Geometric distributions - Uniform, Exponential, Normal distributions

Expected values and moments: Mathematical expectation and its properties - Moments (including variance) and their properties- interpretation - Moment generating function

UNIT - II

15 Periods

Introduction to Statistics: Definition of Statistics - Basic objectives - Applications in various branches of science with examples

Collection of Data: Internal and external data - Primary and secondary Data - Population and sample - Representative sample

Descriptive Statistics: Classification and tabulation of univariate data - graphical representation - Frequency curves

UNIT - III

15 Periods

Descriptive measures: Central tendency and dispersion - Bivariate data - Summarization, marginal and conditional frequency distribution - Scatter diagram - Linear regression and correlation - Least squares method - Rank correlation

UNIT - IV

15 Periods

Sampling Techniques: Random sampling - Sampling from finite and infinite populations - Estimates and standard error (sampling with replacement and sampling without replacement) - Sampling distribution of sample mean - stratified random sampling - Chi-square, t and F distributions

TEXTBOOKS

1. S. M. Ross. *Introduction of Probability Models*, Academic Press, New York, Eleventh Edition, 2014
2. A. Goon, M. Gupta and B. Dasgupta. *Fundamentals of Statistics, Vol. I & II*, World Press, 2013.

REFERENCES

1. S. M. Ross. *A first course in Probability*, Prentice Hall, Ninth Edition, 2015

2. I. R. Miller, J.E. Freund and R. Johnson. *Probability and Statistics for Engineers*, PHI, Ninth Edition, 2017.
3. A. M. Mood, F.A. Graybill and D.C. Boes. *Introduction to the Theory of Statistics*, McGraw Hill Education, Third Edition, 1973

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Interpret how probability can be described and apply the probability techniques to solve various problems• Study the probability distributions and their applications
Unit II	<ul style="list-style-type: none">• Analyze the concepts of statistics and their applications in various branches of science• Classify the diagrammatic representations, frequency distribution and their applications
Unit III	<ul style="list-style-type: none">• Apply various measures of averages and deviations to analyze data• Study the relationship between the variables along with straight line form
Unit IV	<ul style="list-style-type: none">• Understand the concepts of sampling theory and their applications• Apply various sampling techniques to analyze data

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyze the concepts of probability and its applications
- Apply various distributions to solve problems in various domains
- Understand various measures of averages and deviations to analyze data
- Study and analyze the relationship between the bivariate data
- Provide the concepts of sampling theory and techniques to analyze data
- Apply various large sample tests and applications to analyze data

L	T	P	C
2	1	0	3

Course Code: CSE106**Semester: I**

FUNDAMENTALS OF COMPUTER SCIENCE

Course Objectives:

This course will help the learner to formulate simple algorithms for arithmetic, logical problems. Translate the algorithms into ANSI C programs using operators, control flow statements, arrays, functions, pointers and structures.

UNIT - I

10 Periods

General problem Solving concepts: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

Introduction: Imperative languages - syntax and constructs of a specific language (ANSI C) - Types Operator and Expressions with discussion of variable naming and Hungarian Notation - Variable Names - Data Type and Sizes (Little Endian Big Endian) - Constants - Declarations - Arithmetic Operators - Relational Operators - Logical Operators - Type Conversion - Increment Decrement Operators - Bitwise Operators - Assignment Operators and Expressions - Precedence and Order of Evaluation - proper variable naming and Hungarian Notation

UNIT - II

10 Periods

Control Flow Statements: Control Flow with discussion on structured and unstructured programming - Statements and Blocks - If-Else-If - Switch - Loops - while, do, for, break and continue - Goto Labels - structured and un structured programming.

Functions: Functions and Program Structure with discussion on standard library - Basics of functions - parameter passing and returning type - C main return as integer, External, Auto, Local, Static, Register Variables - Scope Rules - Block structure - Initialization - Recursion - Preprocessor - Standard Library Functions and return types.

UNIT - III

13 Periods

Pointers and Arrays: Pointers and address - Pointers and Function Arguments - Pointers and Arrays - Address Arithmetic - character Pointers and Functions - Pointer Arrays - Pointer to Pointer - Multi-dimensional array and Row/column major formats - Initialization of Pointer Arrays - Command line arguments - Pointer to functions - complicated declarations and how they are evaluated.

Structures: Basic Structures - Structures and Functions - Array of structures - pointer of structures - Self-referral Structures - Table look up - Typedef - Unions - Bit-fields

UNIT - IV**12 Periods**

Files Input Output: Input and Output Standard I/O - Formatted Output -printf - Formatted Input - scanf - Variable length argument list - file access including FILE structure - fopen - stdin, stdout and stderr - Error Handling including exit - perror and error.h - Line I/O - related miscellaneous functions.

UNIX system Interface: Unix system Interface - File Descriptor - Low level I/O - read and write, Open, create, close and unlink - Random access -lseek - Discussions on Listing Directory - Storage allocator.

Programming Method: Debugging - Macro - User Defined Header - User Defined Library Function - makefile utility

TEXTBOOKS

1. B. W. Kernighan and D. M. Ritchi. *The C Programming Language*, PHI, Second edition, 2015.
2. B. Gottfried. *Programming in C*, Schaum Outline Series, Third Edition, 2017.

REFERENCES

1. Herbert Schildt. *C: The Complete Reference*, McGraw Hill, Fourth Edition, 2017.
2. Yashavant Kanetkar. *Let Us C*, BPB Publications, Sixteenth Edition, 2017.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Identify the basic concepts of problem solving techniques• Develop programs to perform different mathematical operations using operators
Unit II	<ul style="list-style-type: none">• Select an appropriate construct to solve the given problem• Design programs using functions, branching and looping constructs
Unit III	<ul style="list-style-type: none">• Illustrate the operations on arrays• Experiment with structures and pointers for developing a given application
Unit IV	<ul style="list-style-type: none">• Construct simple application using formatted input and output statements• Demonstrate the file access programs using built in functions

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Illustrate a functional hierarchical code organization in ANSI C
- Interpret the different operators for performing mathematical operations
- Construct the programs using functions, branching and looping
- Demonstrate pointers and arrays in a given application
- Build an application to perform file access using built in function
- Propose a solution for the real time problems using C constructs

L	T	P	C
3	0	0	3

Course Code: EEE104**Semester: I**

PRINCIPLES OF ELECTRICAL ENGINEERING

Course Objectives:

This course will help the learner to apply basic concepts of DC and AC circuits, make use of the principles of electrostatics and electro mechanics, understand the basic methods for the measurement of electrical quantities, and to explore the concept of electrical wiring and safety measures.

UNIT - I

12 Periods

Basic Concepts and Circuit Analysis: Concept of Potential difference, voltage, current - Fundamental linear passive and active elements to their functional current-voltage relation - Terminology and symbols in order to describe electric networks - Concept of work, power, energy and conversion of energy.

DC Circuits: Current-voltage relations of electric network by mathematical equations to analyse the network - voltage source and current sources, ideal and practical - Kirchhoff's laws and applications to network solutions using mesh analysis - Simplifications of networks using series-parallel, Star/Delta transformation - Superposition theorem - Thevenin's theorem - Norton's Theorem - Maximum Power Transfer theorem

UNIT - II

10 Periods

AC Circuits: AC waveform definitions - Form factor - Peak factor - study of R-L - R-C -RLC series circuit - R-L-C parallel circuit - phasor representation in polar and rectangular form - concept of impedance - admittance - active - reactive - apparent and complex power - power factor - 3 phase Balanced AC Circuits

UNIT - III

12 Periods

Principle of Electrostatics and Electro-mechanics: Electrostatic field - electric field intensity - electric field strength - absolute permittivity - relative permittivity - capacitor composite - dielectric capacitors - capacitors in series & parallel - energy stored in capacitors - charging and discharging of capacitors - Principle of batteries - types - construction and application.

Electro-mechanics: Electricity and Magnetism - magnetic field and faraday's law - self and mutual inductance - Ampere's law - Magnetic circuit - Magnetic material and B-H Curve - Single phase transformer - principle of operation - EMF equation - voltage ratio - current ratio - KVA rating - efficiency and regulation - Electromechanical energy conversion - Basic concept of indicating and integrating instruments

UNIT - IV

11 Periods

Measurements and Sensors: Introduction to measuring devices /sensors and transducers related to electrical signals - Elementary methods for the measurement of electrical quantities in DC and AC systems and their practical application.

Electrical Wiring and Illumination system: Basic layout of distribution system - Types of Wiring System & Wiring Accessories - Necessity of earthing - Types of earthing - Different types of lamps (Incandescent, Fluorescent, Sodium Vapour, Mercury Vapour, Metal Halide, CFL, LED)

TEXTBOOKS

1. A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen. *Electric Machinery*, Tata McGraw Hill, Sixth Edition, 2005.
2. B. L. Theraja. *A Textbook of Electrical Technology*. Vol. I, S. Chand and Company Ltd., New Delhi, 2012.
3. V. K. Mehta. *Basic Electrical Engineering*, S. Chand and Company Ltd, New Delhi, 2006.
4. J. Nagrath and Kothari. *Theory and problems of Basic Electrical Engineering*, Prentice Hall of India Pvt. Ltd., Second Edition, 2004.

REFERENCES

1. Edward Hughes. *Electrical Technology*, Pearson Education Publication, Tenth Edition, 2011.
2. Vincent. Del. Toro. *Electrical Engineering Fundamentals*, Prentice Hall India, Second Edition, 1986.
3. Sudhakar Shyam Mohan. *Circuits and Networks: Analysis and Synthesis*, Tata McGraw Hill Education, Fifth Edition, 2010.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Apply the basic concepts of DC circuit and analyze a circuit using mesh analysis.• Analyse a circuit using Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem and Superposition theorems
Unit II	<ul style="list-style-type: none">• Analyze steady state behaviour of AC circuits with R, R-L, R-C, and R-L-C circuits• Find power and power factor in three phase balanced AC circuits
Unit III	<ul style="list-style-type: none">• Recall the concept of electrostatic fields and explain the construction and applications of batteries• Understand the generation of statically induced EMF in a transformer and explain the construction and operation of transformers
Unit IV	<ul style="list-style-type: none">• Summarise Elementary methods for the measurement of electrical quantities• Demonstrate simple domestic wiring and classify various types of lamps

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyse DC circuits using mesh analysis and apply network theorems
- Analyse AC circuits and find power and power factor in three phase AC circuits
- Relate the concepts of electrostatics and electromagnetics to understand the construction and applications of batteries and transformers
- Summarise various methods for the measurement of electrical quantities and demonstrate domestic wiring concepts
- Classify various types of lamp loads

L	T	P	C
3	0	0	3

Course Code: PHY137

Semester: I

FUNDAMENTALS OF PHYSICS

Course Objectives:

This course will help the learner to familiarize with the theories and fundamentals of harmonic oscillator, interference, diffraction, polarization, quantum physics, crystallography, semiconductors, laser, optical fibre and Thermodynamics, to understand applications using basic concepts and quantify the physical quantities involved in a phenomenon.

UNIT - I

15 Periods

Quantum Mechanics: Introduction - Planck's quantum theory - Matter waves, de-Broglie wavelength - Heisenberg's Uncertainty principle - time independent and time dependent Schrödinger's wave equation - Physical significance of wave function - Particle in a one dimensional potential box - Heisenberg Picture.

Crystallography: Basic terms-types of crystal systems - Bravais lattices - miller indices - d spacing - Debye Scherrer powder method - Laue method- Atomic packing factor for SC - BCC - FCC and HCP structures.

Semiconductor Physics: Conductor - semiconductor and Insulator; Basic concept of Band theory in Solids

UNIT - II

15 Periods

Interference-principle of superposition-young's experiment: Theory of interference fringes-types of interference-Fresnel's prism- Newton's rings Diffraction Two kinds of diffraction-Difference between interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence.

Electromagnetisms, Maxwell's Equations: Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane - elliptical and circularly polarized light - Brewster's law - double refraction.

UNIT - III

15 Periods

Oscillation and fundamental of wave optics: Periodic motion-simple harmonic motion-characteristics of simple harmonic motion - vibration of simple springs mass system. Resonance-definition- damped harmonic oscillator - heavy –critical and light damping - energy decay in a damped harmonic oscillator - quality factor –forced mechanical and electrical oscillators

UNIT - IV

15 Periods

Laser: Properties of laser beams: mono-chromaticity - coherence - directionality and brightness-Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion - different types of lasers: Ruby Laser - CO₂ and Neodymium lasers; laser speckles - applications of lasers in engineering.

Fiber optics - Types of optical fibers- Applications.

Thermodynamics: Zeroth law of thermodynamics - first law of thermodynamics - brief discussion on application of 1st law - second law of thermodynamics and concept of Engine - entropy - change in entropy in reversible and irreversible processes - third law of thermodynamics

TEXTBOOKS

1. Beiser A. *Concepts of Modern Physics*, McGraw Hill International, Sixth Edition, 2003.
2. David Halliday, Robert Resnick, and Jearl Walker. *Fundamentals of Physics*, John Wiley & Sons, Inc, Ninth Edition, 2011.

REFERENCES

1. AjoyGhatak, *Optics*, Tata McGraw Hill, Fifth Edition, 2010.
2. Sears and Zemansky, *University Physics*, Addison-Wesley, Tenth Edition, 1999.
3. Jenkins and White, *Fundamentals of Optics*, McGraw-Hill, Fourth Edition, 2001.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Classify the inadequacy of classical mechanics• Summarize the important theories of quantum physics• Determine the behaviour of subatomic particles using Schrodinger equation• Classify solids based on band theory
Unit II	<ul style="list-style-type: none">• Distinguish the behaviour of light due to its wave nature• Discuss about Maxwell's equations and Simple Harmonic motions
Unit III	<ul style="list-style-type: none">• Define types of periodic motion• Analyse factors influencing SHM
Unit IV	<ul style="list-style-type: none">• Select appropriate laser for specific application• Define the laws governing thermodynamic processes

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Understand the significance and applications of Quantum Mechanics, Crystal structure and band theory in solids
- Classify the solids based on band theory
- Explain Young's experiment and Fraunhofer diffraction
- Discuss about Maxwell's equations and Simple Harmonic motions
- Select appropriate laser for specific application and design fibre optic communication
- Describe the laws of Thermodynamic processes

L	T	P	C
3	0	0	3

Course Code: ENG136

Semester: I

BUSINESS COMMUNICATION & VALUE SCIENCE – I

Course Objectives:

This course will help the learner to understand what life skills are and their importance in leading a happy and well-adjusted life, motivate students to look within and create a better version of self and understand the key concepts of values, life skills and business communication.

UNIT - I

10 Periods

Business Communication Basics: Self Introduction -Need for Life Skills and Values - Self-Work with Immersion -General vs Business Communication - Newspaper Report Writing - Self-awareness - Stress management

UNIT - II

10 Periods

Basic Grammar: Parts of Speech - Tenses -Sentence formation -Common errors - Voices Barriers of Communication - Effective Communication - Verbal and Non - Verbal - Importance of Listening Skills - Listening vs Hearing - Types of Listening - SWOT Analysis

UNIT - III

12 Periods

Vocabulary and Writing: E-Mail Writing - Pronunciation - Vocabulary Enrichment-Words, Phrases and Idioms - Toastmaster Speech - Summary Writing - Story Writing - Resume Writing - Team Work - Movie based learning for life Skills and Values

UNIT - IV

13 Periods

Life Skills: Life Skills - Multiple Intelligences - Leadership Quality - Dealing with Ambiguity - Motivating the People

TEXTBOOKS

There are no prescribed texts – there will be handouts and reference links shared.

REFERENCES

1. English vocabulary in use – Alan Mc'carthy and O'dell
2. APAART: Speak Well 1 (English language and communication)
3. APAART: Speak Well 2 (Soft Skills)
4. Business Communication – Dr. Saroj Hiremath

ONLINE MATERIALS

1. Train your mind to perform under pressure- Simon sinek
<https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/>
2. Brilliant way one CEO rallied his team in the middle of layoffs
<https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html>

3. Will Smith's Top Ten rules for success <https://www.youtube.com/watch?v=bBsT9omTeh0>
4. <https://www.coursera.org/learn/learning-how-to-learn>
5. <https://www.coursera.org/specializations/effective-business-communication>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	• Recognize the need for life skills and values
Unit II	• Recognize own strengths and opportunities
Unit III	• Apply the life skills to different situations
Unit IV	• Understand the basic tenets of communication

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Recognize the need for life skills and values and recognize own strengths and opportunities
- Apply the life skills to different situations and understand the basic tenets of communication.
- Applies the basic communication practices in different types of communication

L	T	P	C
0	0	2	1

Course Code: CSE107**Semester: I****FUNDAMENTALS OF COMPUTER SCIENCE LABORATORY****Course Objectives:**

This course will help the learners to understand a strong formal foundation in problem solving techniques. The learners will be able to implement the algorithms and analyze their complexity. The learners will be able to identify the correct and efficient ways of solving problems using ANSI C.

LIST OF EXPERIMENTS

1. Algorithm and flowcharts of small problems (GCD, Prime no generation, etc...)
2. Programs using input, output statements and operators
3. Programs using proper parameter passing
4. Programs using command line Arguments
5. Programs using function with variable parameter
6. Programs using pointer to functions
7. Programs using user defined header
8. Demonstrate Make file utility
9. Programs using multi file program and user defined libraries
10. Programs using substring matching or searching
11. Programs using parsing related assignments

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Outline basic knowledge in problem solving techniques, algorithms and flow chart
- Design various algorithms, and develops the basic concepts and terminology of programming in general
- Construct real time applications using the power of C language features like functions, strings, files and pointers.
- Apply Make file utility in real time projects.
- Demonstrate file management systems using built in functions

:

L	T	P	C
0	0	2	1

Course Code:EEE105**Semester: I**

PRINCIPLES OF ELECTRICAL ENGINEERING LABORATORY

Course Objectives:

This course will help the learner to verify basic laws of electric circuits and network theorem, simulate basic R-L-C series circuits and to study the time response of RC circuits, verify voltage current relationship in three phase system, and demonstrate electric wiring and electric power supply system.

LIST OF EXPERIMENTS

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits
2. Determination of resistance temperature coefficient
3. Verification of basic laws of electric circuits
4. Verification of voltage division and current division rules
5. Verification of Thevenin's and Norton's Theorem
6. Verification of Superposition and Maximum Power Transfer theorem
7. Simulation of R-L-C series circuits for $X_L > X_C$, $X_L < X_C$ & $X_L = X_C$
8. Simulation of Time response of RC circuit
9. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
10. Demonstration of measurement of electrical quantities in DC and AC systems.
11. Voltage-current relationship in a R-L & R-C series circuits and to determine the power factor of the circuit
12. Domestic wiring
13. Demonstration of electric power supply system
14. Demonstration of statically induced EMF

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyse electric networks using basic laws and network theorems
- Interpret the simulation results of R-L-C series circuits
- Summarize the voltage-current relationship in three phase system
- Demonstrate domestic wiring and electric power supply system

L	T	P	C
0	0	2	1

Course Code: PHY139

Semester: I

FUNDAMENTALS OF PHYSICS LABORATORY

Course Objectives:

To enable the learners to have hands on experience to verify various laws physics in the fields like Semiconductors, Quantum physics, light and Thermodynamics.

LIST OF EXPERIMENTS

- 1) Magnetic field along the axis of current carrying coil - Stewart and Gee.
- 2) Determination of Hall coefficient of semiconductor.
- 3) Determination of Plank constant.
- 4) Determination of wave length of light by Laser diffraction method.
- 5) Determination of wave length of light by Newton's Ring method.
- 6) Determination of laser and optical fiber parameters.
- 7) Determination of Stefan's Constant.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyse variations in the magnetic field due to changing current
- Identify type of material using hall coefficient
- Experiment with photo electric effect to show particle behaviour of light
- Relate wave nature of light and diffraction phenomena
- Relate wave nature of light and interference phenomena
- Make use of law of reflection and other laws light
- Relate properties of materials with thermal energy

L	T	P	C
0	0	2	1

Course Code: ENG137

Semester: II

BUSINESS COMMUNICATION & VALUE SCIENCE - I LABORATORY

Course Objectives:

This course will help the learner to understand what life skills are and their importance in leading a happy and well-adjusted life, look within and create a better version of self, understand the key concepts of values, life skills and business communication

LIST OF EXERCISES

1. Skit Based Communication
2. Listening Responding to audio
3. Create a Podcast on a topic
4. Working with an NGO and making a presentation
5. Presentation on the persona of any well-known person
6. Role-Play
7. Join a trek –Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation
8. Create a musical using the learning from unit 3

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Work with NGOs or any organizations
- Create a Podcast on a topic
- Participate in Skits and role plays
- Make effective presentations

L	T	P	C
3	1	0	4

Course Code: MAT134
Semester: II

LINEAR ALGEBRA

Course Objectives:

This course will help the learner to study the fundamental concepts of linear algebra culminating in abstract vector spaces and linear transformations. The course starts with systems of linear equations and some basic concepts of the theory of vector spaces in the concrete setting of real linear n -space. The course then goes on to introduce abstract vector spaces over arbitrary fields and linear transformations, matrices, matrix algebra, similarity of matrices, eigenvalues and eigenvectors. The subject material is of vital importance in image processing and machine learning.

UNIT - I

15 Periods

Introduction to Matrices and Determinants: Solution of Linear Equations - Cramer's rule - Inverse of a Matrix.

Vectors and linear combinations: Rank of a matrix - Gaussian elimination - LU Decomposition - Solving Systems of Linear Equations using the tools of Matrices

UNIT - II

15 Periods

Vector space: Dimension - Basis - Orthogonality - Projections - Gram-Schmidt orthogonalization and QR decomposition

UNIT - III

15 Periods

Eigenvalues and Eigenvectors: Positive definite matrices - Linear transformations - Hermitian and unitary matrices

UNIT - IV

15 Periods

Singular value decomposition and Principal component analysis - Introduction to their applications in Image Processing and Machine Learning

REFERENCES

1. B. S. Grewal. *Higher Engineering Mathematics*, Khanna Publishers, Forty Third Edition, 2014.
2. Peter V. O'Neil. *Advanced Engineering Mathematics*, Seventh Edition, Cengage Learning, 2011.
3. Michael. D. Greenberg. *Advanced Engineering Mathematics*, Pearson Education, Second Edition, 1998.
4. Gilbert Strang, *Introduction to linear algebra*, Wellsely-Cambridge Press, Fifth Edition, 2016.
5. WartikarP.N, WartikarJ.N. Textbook of *Applied Mathematics*, Volume I and II, Vidyarthi Prakashan, 2010.
6. R C Gonzalez and R E Woods. *Digital Image Processing*, Pearson Education, Third Edition, 2007.
7. <https://machinelearningmastery.com/introduction-matrices-machine-learning/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	Know the basic idea of matrices, determinants, Rank of a matrix and System of linear equations
Unit II	Understand the basic concepts of vector space namely basis, dimensions, orthogonality and Gram-Schmidt orthogonalization
Unit III	Learn the different types of matrices and their eigen values and eigen vectors
Unit IV	Study singular value decomposition and their applications in image processing and machine learning

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyze different types of matrices and their properties
- Solve problems in orthogonalisation
- Classify the nature of the square matrices through their eigen values
- Apply the decomposition techniques in image processing with the help of machine learning

L	T	P	C
3	1	0	4

Course Code: MAT244

Semester: II

STATISTICAL MODELLING

Course Objectives:

An in-depth introduction to statistical inference with linear statistical models and basic time series analysis. Topics include estimation, testing of hypothesis analysis of variance and nonparametric inferences. R programming language to perform data analyses and generate reproducible reports.

UNIT - I

15 Periods

Linear Statistical Models: Simple linear regression & correlation - multiple regression & multiple correlation.

Basics of Time Series Analysis & Forecasting: Stationary - ARIMA Models - Identification - Estimation and Forecasting

UNIT - II

15 Periods

Estimation: Point estimation - criteria for good estimates (un-biasedness, consistency) - Methods of estimation including maximum likelihood estimation.

Sufficient Statistic: Concept & examples - complete sufficiency - their application in estimation.

Test of hypothesis: Concept & formulation - Type I and Type II errors - Neyman Pearson lemma - Procedures of testing

UNIT - III

15 Periods

Analysis of variance: one way - two way with as well as without interaction.

Non-parametric Inference: Comparison with parametric inference - Use of order statistics. Sign test - Wilcoxon signed rank test - Mann-Whitney test - Run test - Kolmogorov-Smirnov test - Spearman's and Kendall's test - Tolerance region

UNIT - IV

15 Periods

R statistical programming language: Introduction to R - Functions - Control flow and Loops - Working with Vectors and Matrices - Reading in Data - Writing Data - Working with Data - Manipulating Data - Simulation - Linear model - Data Frame - Graphics in R

REFERENCES

1. I. R. Miller, J.E. Freund and R. Johnson. *Probability and Statistics for Engineers*, PHI, Ninth Edition, 2017
2. Gun, A. M., M. K. Gupta, and B. Dasgupta. *Fundamentals of Statistics*, Volume 1 & Volume II, World Press, 2013
3. Chatfield, Chris. *The analysis of time series: An Introduction*, Chapman and Hall/CRC, Sixth Edition, 2003.
4. Montgomery, Douglas C., Elizabeth A. Peck, and G. Geoffrey Vining. *Introduction to Linear Regression Analysis*, John Wiley & Sons, 2012.
5. Mood, Alexander McFarlane. *Introduction to the Theory of Statistics*, McGraw Hill, 1950.
6. Draper, Norman R., and Harry Smith. *Applied regression analysis. Vol. 326*, John Wiley & Sons, 2014.

7. Grolemond, Garrett. *Hands-On Programming with R: Write Your Own Functions and Simulations*, O'Reilly Media, Inc, 2014.
8. Lander, Jared P. *R for Everyone: Advanced Analytics and Graphics*, Pearson Education, 2014.
9. www.rbi.org.in

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	Understand correlation and Regression analysis and their properties and also the concepts of time series analysis
Unit II	Learn the concepts of testing of hypothesis and estimation theory
Unit III	Know the ideas of ANOVA and different nonparametric tests
Unit IV	Learn the basics of R statistical programming

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Use linear statistical models to make predictions and explain relationships of the data
- Estimate the required parameters from the sample statistics and Interpret modelling results in the context of real-world problems
- Make important decisions from few samples which are taken out of unmanageably huge populations
- Use the open source programming language R for the analysis of data arising from both observational studies and designed experiments

L	T	P	C
2	1	0	3

Course Code: CSE209

Semester: II

DATA STRUCTURES & ALGORITHMS

Course Objectives:

This course will help the learner to understand the algorithm performance analysis, linear and non-linear data structures. The learner will be able to choose appropriate data structures and efficient searching and sorting techniques for a given application.

UNIT - I

11 Periods

Basic Terminologies & Introduction to Algorithm and Data Organisation: Introduction - Algorithm specification - Recursion - Performance analysis. Asymptotic Notation - The Big-O - Omega and Theta notation. Programming Style - Refinement of Coding - Time complexity-Space complexity- Trade Off - Testing - Data Abstraction

UNIT - II

11 Periods

Linear Data Structure: Array - Abstract data type-Polynomial ADT - Stack - Stack ADT - Evaluation of expression - Queue - Queue ADT - Linked-list and its types - SLL, CLL, DLL - Various Representations - Operations & Applications of Linear Data Structures.

UNIT - III

12 Periods

Non-linear Data Structure: Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected) - Various Representations: Tree - List - left child-right sibling - degree two tree - Graph - Adjacency matrix - adjacency List - Multi list - weighted edges. **Operations:** insertion - deletion-search and traversal algorithms and complexity analysis. Applications of Non-Linear Data Structures.

UNIT - IV

11 Periods

Searching and Sorting on Various Data Structures: Sequential Search - Binary Search - Breadth First Search - Depth First Search - Insertion Sort - Selection Sort - Shell Sort - Divide and Conquer Sort - Merge Sort - Quick Sort - Heap Sort - Introduction to Hashing - static hashing - Dynamic hashing.

File: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes.

TEXTBOOKS

1. E. Horowitz, S. Sahni, and S. Anderson-Freed. *Fundamentals of Data Structures in C*, Second Edition, University Press, 2008.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, *Data Structures and Algorithms*, Pearson Education, First Edition, Reprint 1987.

REFERENCES

1. Donald E. Knuth, *The Art of Computer Programming: Volume 1: Fundamental Algorithms.*, Addison-Wesley, Pearson Education, Third Edition, 1997
2. Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, Third Edition, 2010.

3. Morin, Pat. *Open Data Structures: An Introduction. Vol. 2*, Athabasca University Press, Thirty first Edition, 2013.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Define asymptotic notations for time complexity analysis• Find time complexity for a given algorithm
Unit II	<ul style="list-style-type: none">• Choose appropriate representation of a Linear data structure• Identify linear data structures like stack, queue and linked lists operations• Employ appropriate linear data structure in application development
Unit III	<ul style="list-style-type: none">• Choose appropriate representation of a tree and graph• Identify non-linear data structures like Trees and graphs operations• Employ appropriate non-linear data structure in application development
Unit IV	<ul style="list-style-type: none">• Select appropriate searching and sorting algorithm based on time complexity analysis for a given application• Choose appropriate hashing technique for the given key valued data

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Define asymptotic notations for time complexity analysis
- Find time complexity for a given algorithm
- Choose appropriate representation of a Linear and non-linear data structure
- Identify linear and non-linear data structures operations
- Employ appropriate linear and non-linear data structure in application development
- Select appropriate searching and sorting algorithm based on time complexity analysis for a given application
- Choose appropriate hashing technique for the given key valued data

L	T	P	C
3	0	0	3

Course Code: EIE219

Semester: II

PRINCIPLES OF ELECTRONICS

Course Objectives:

This course will help the learner to construct amplifiers and oscillators by biasing semiconductor devices and integrated circuits based on its V-I characteristics and feedback mechanisms. It will also help the learner to perform arithmetic operations using Boolean logic reduction.

UNIT - I

10 Periods

Basics of Semiconductors: Energy band theory, Fermi levels - Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic (P&N-type), Energy band diagram, drift & diffusion currents.

Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, V-I characteristics, Zener Diode & its Characteristics. Rectifier circuits: half wave, full wave, Peak Inverse Voltage, DC voltage and current, ripple factor, efficiency, idea of regulation.

UNIT - II

12 Periods

Bipolar Junction Transistors: Formation of PNP / NPN junctions, Working principle of CE, CB, CC configuration, transistor characteristics: cut-off, active and saturation mode, transistor action and current amplification factors for CB and CE modes. Biasing: Fixed, Emitter feedback and Voltage divider bias.

Field Effect Transistors: Concept of Field Effect Transistors (channel width modulation), JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type - CS, CG, CD configurations - CMOS: Basic Principles

UNIT - III

11 Periods

Feed Back Concepts: Concept (Block diagram), positive and negative feedback, loop gain, open loop gain, feedback factors.

Operational Amplifiers: Introduction to integrated circuits, operational amplifier and its ideal characteristics - Application of operational amplifier - inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator.

UNIT - IV

12 Periods

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map.

Implementation of Digital Circuits: Half and full adder / subtractor, Basics of multiplexers, demultiplexers and flip-flops.

TEXTBOOKS

1. M. Morris Mano and Michael D. Ciletti. *Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog*, Pearson education, Sixth Edition, 2018.
2. Jacob Millman, Christos C. Halkias, Satyabrata Jit, *Electronic Devices and Circuits*, McGraw Hill Education, Fourth Edition, 2015.
3. Robert L. Boylestad and Louis Nashelsky. *Electronic Devices and Circuit Theory*, Pearson Education, Eleventh Edition, 2015.

REFERENCES

1. S. Salivahanan and N. Suresh Kumar, A. Vallavaraj, *Electronic Devices and Circuits*, McGraw Hill Education, Fourth Edition, 2016.
2. Donald A. Neamen, *Electronic Circuits Analysis and Design*, McGraw Hill Education, Third Edition, 2006.
3. R. P. Jain. *Modern Digital Electronics*, Third Edition, McGraw Hill Education, 2010.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Explain the formation of diodes• Use various diode for building a DC power source• Analyse the performance of the rectifier circuits
Unit II	<ul style="list-style-type: none">• Elaborate the concept of PNP and NPN transistors• Analyse the characteristics of transistors and their operating regions• Provide bias to the transistors for the required operation
Unit III	<ul style="list-style-type: none">• Choose the type of feedback for the given application• Apply operational amplifiers to realize various signal processing technique
Unit IV	<ul style="list-style-type: none">• Differentiate analog and digital systems• Derive the logical expression for the given application• Design combinational and sequential logic circuits using logic gates

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Design and analyse rectifiers using diodes
- Analyse the characteristics of various transistors and design amplifiers
- Design analog computational circuits using operational amplifiers
- Design digital logic circuits to implement the given Boolean expression and counters

L	T	P	C
2	0	0	2

Course Code: MGT131

Semester: II

FUNDAMENTALS OF ECONOMICS

Course Objectives:

This course will help the learner to understand how markets and other governance structures organize and regulate the economic activities resulting in production, consumption, distribution and exchange and also about the determinants of macroeconomic conditions prevalent in the economy and thereby familiarizing themselves in the process with major economic theories of relevance.

UNIT - I

8 Periods

Introduction to Microeconomics: Principles of Demand and Supply - Supply Curves of Firms - Elasticity of Supply - Demand Curves of Households - Elasticity of Demand - Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve) - Welfare Analysis - Consumers' and Producers' Surplus - Price Ceilings and Price Floors - Consumer Behaviour - Axioms of Choice - Budget Constraints and Indifference Curves - Consumer's Equilibrium - Effects of a Price Change, Income and Substitution Effects - Derivation of a Demand Curve - Applications - Tax and Subsidies - Inter temporal Consumption - Suppliers' Income Effect

UNIT - II

7 Periods

Introduction to Production, Costs and Market structures: Theory of Production - Production Function and Iso-quants - Cost Minimization - Cost Curves - Total, Average and Marginal Costs - Long Run and Short Run Costs - Equilibrium of a Firm under Perfect Competition - Monopoly and Monopolistic Competition

UNIT - III

7 Periods

Introduction to Macroeconomics: National Income and its Components - GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector - Taxes and Subsidies; External Sector - Exports and Imports

UNIT - IV

8 Periods

Introduction to Money: Money - Definitions; Demand for Money - Transaction and Speculative Demand; Supply of Money - Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets - IS, LM Model; Business Cycles and Stabilization - Monetary and Fiscal Policy - Central Bank and the Government; The Classical Paradigm - Price and Wage Rigidities - Voluntary and Involuntary Unemployment

TEXTBOOKS

1. Pindyck, Robert S., and Daniel L. Rubinfeld, Microeconomics, Eighth Edition, Pearson Education, 2013.
2. Dornbusch, Fischer and Startz, Macroeconomics, Tenth Edition, McGraw Hill, 2012.
3. Paul Anthony Samuelson, William D. Nordhaus, Economics, Nineteenth Edition, McGraw Hill, 2009

REFERENCES

1. Varian, Hal R. *Intermediate Microeconomics: A Modern Approach*, Ninth International Student Edition, WW Norton & Company, 2014.
2. Mankiw, N. Gregory. *Principles of Macroeconomics (Mankiw's Principles of Economics)*, 2011.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	• Relate the economic concepts such as demand, supply, pricing etc to the theories and the behaviour of the firm, industry and government
Unit II	• Infer the functioning of various market structures
Unit III	• Identify the determinants of flow of money in the economy
Unit IV	• Understand the creation of credit in the economy

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Explain the optimization techniques followed by a firm/industry
- Examine the cost structure of the firm
- Evaluate the linkages between financial markets and the real economy
- Discuss the impact of monetary and fiscal policies in the regulation of credit

L	T	P	C
3	0	0	3

Course Code: ENG138

Semester: II

BUSINESS COMMUNICATION & VALUE SCIENCE – II

Course Objectives:

This course will help the learner to develop effective writing, reading, presentation and group discussion skills, identify personality traits and evolve as a better team player, understand the key concepts of Morality, Behavior and beliefs, Diversity & Inclusion.

UNIT - I

10 Periods

Communication Basics: Icebreaker - JAM-Comment on any social issue with your suggestion - Expressing one's view to Agree or disagree - Group Discussion - Principles of Paragraph Writing - Catherine Morris and Joanie McMahon's writing techniques - Report writing on the discussion - Common errors - punctuation rules - Collocations

UNIT - II

10 Periods

Reading and Writing: Preparing a poster or pamphlet with vision, mission, value statement, tagline and a logo - Presentation skills - Writing an article - Reading Strategies- skimming and scanning

UNIT - III

12 Periods

Soft Skills and Spoken Communication: Art of speaking - Enacting a Skit - Feedback and its use - Use electronic or social media to share concepts and ideas - Six speaking personalities - Belbin's 8 Team Roles & Player styles - Lindgren's Big 5 personality traits

UNIT - IV

13 Periods

Personal and Corporate Values: Perspectives on Moral Development and Moral Diversity - Different forms of Diversity - Empathy vs Sympathy - Film and Book review - Features of Short Story - Narrative types and techniques - Writing a Review in a blog - Power Point Presentation - Interviewing a delegates and a public - interviewing techniques - Debate - Art of persuasive communication - TCS values and Respect for Individual and Integrity - Updating one's Resume

TEXTBOOK

There are no prescribed texts - there will be handouts and reference links shared.

REFERENCES

1. Dr.A.P.J Abdul Kalam and Arun Tiwari, *Guiding Souls: Dialogues on the Purpose of Life*, 2005.
2. Dr.A.P.J Abdul Kalam and Acharya Mahapragya, *The Family and the Nation*, 2015
3. Dr.A.P.J Abdul Kalam and Y.S.Rajan, *The Scientific India: A Twenty First Century Guide to the World Around Us*, 2011.
4. Dr.A.P.J Abdul Kalam, *Forge Your Future: Candid, Forthright, Inspiring*, 2014
5. Peter H. Diamandis and Steven Kotler, *Abundance: The Future is Better Than You Think*, Free Press Publishers, 2012.
6. Simon Sinek, *Start With Why: How Great Leaders Inspire Everyone to Take Action*, Penguin Publisher, 2011

7. Sandra Moriarty, Nancy D. Mitchell, William D. Wells, *Advertising & IMC: Principles and Practice*, Pearson Education India, 2016

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	• Acquaint with the basics of spoken and written communication
Unit II	• Perform some reading and writing tasks
Unit III	• Acquire soft skills and speak in formal and informal situations
Unit IV	• Obtain some useful personal and corporate values

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Use the basic tools of structured spoken and written communication
- Use electronic/social media to share concepts and ideas
- Apply effective techniques to make presentations
- Understand the basic concepts of Morality and Diversity

Course Code: CSE210
Semester: II

L	T	P	C
0	0	2	1

DATA STRUCTURES & ALGORITHMS LABORATORY

Course Objectives:

This course will help the learner to select appropriate data structure, design technique and algorithm for a given application.

LIST OF EXPERIMENTS

1. Create a Stack and perform the stack operations using arrays.
2. Towers of Hanoi using user defined stacks.
3. Create queue and perform the queue operation using arrays
4. Reading, writing, and addition of polynomials.
5. Line editors with line count, word count showing on the screen.
6. Trees with all operations- Binary search tree, AVL tree
7. All graph algorithms- BFS and DFS
8. Sorting Techniques-Insertion sort, Merge sort
9. Searching techniques - Binary search and Hash search
10. Saving / retrieving non-linear data structure in/from a file

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Demonstrate operations on linear data structures using arrays and linked list
- Employ linked implementation for non-linear data structures
- Select appropriate data structure to solve a given problem
- Demonstrate different sorting and searching algorithms
- Demonstrate files for non-linear data structure
- Develop programs using appropriate design technique for an application

L	T	P	C
0	0	2	1

Course Code: EIE220

Semester: II

PRINCIPLES OF ELECTRONICS LABORATORY

Course Objectives:

This course will help the learner to analyse the characteristic of various diodes and transistors, design analog computational circuits using operational amplifiers, and design digital logic circuits using logic gates

LIST OF EXPERIMENTS

1. Analyse V-I characteristics of PN junction diode
2. Analyse V-I characteristics of Zener diode
3. Design of half-wave and full-wave rectifier circuit using PN junction diode
4. Analysis of BJT characteristics in CE configuration
5. Voltage divider biasing of BJT
6. Analysis of drain and transfer characteristics of FET
7. Design of adder and subtractor using operational amplifiers
8. Design of integrator and differentiator using operational amplifiers
9. Implementation of Boolean expressions using combinational logic circuit
10. Implementation of half and full adder using logic gates
11. Implementation of half and full subtractor using logic gates
12. Construct and check using universal gates the operations of various flip flops

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Bias the given transistor for amplifier applications
- Design circuits to perform analog operations using operational amplifier
- Design logic circuits to realize various logical operations

L	T	P	C
0	0	2	1

Course Code: ENG139

Semester: II

BUSINESS COMMUNICATION & VALUE SCIENCE – II LABORATORY

Course Objectives:

This course will help the learner to develop effective writing, reading, presentation and group discussion skills, identify personality traits and evolve as a better team player, and understand the key concepts of Morality, Behavior and beliefs, Diversity & Inclusion.

LIST OF EXERCISES

1. Group Discussion
2. Create the magazine
3. Launching an E Magazine
4. Prepare and Publish the Second Episode of the E Magazine
5. Enact and Read out the Script of a Skit
6. Promote the Play in Social Media
7. Presentation
8. Prepare and Publish the Third Episode of the E Magazine
9. Narrating a Story
10. Writing a Review in a Blog
11. Debate
12. Giving Persuasive Speech
13. A day with NGO and Share the Experience

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Perform any communication tasks like group discussion, presentation and debating
- Use the social media for communication purposes and work with NGOs.

L	T	P	C
4	1	0	5

Course Code: CSE211

Semester: III

FORMAL LANGUAGE & AUTOMATA THEORY

Course Objectives:

This course will help the learner to discuss different classes of formal languages in Chomsky hierarchy, their properties and to design the acceptor machines for those languages

UNIT - I

18 Periods

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages

Regular languages and finite automata: Deterministic Finite Automata (DFA) - Nondeterministic Finite Automata (NFA) – Finite Automata with Epsilon Transitions – Regular Expressions - Finite Automata and Regular Expressions - Kleene's theorem- Regular grammars and Equivalence with Finite Automata - Properties of Regular Languages: Proving Languages Not to Be Regular–Closure Properties of Regular Languages - Myhill-Nerode theorem -Minimization of Finite Automata

UNIT - II

19 Periods

Context-free languages and pushdown automata: Context-free grammars (CFG) – Parse Trees - Ambiguity in Grammars and Languages - nondeterministic pushdown automata (PDA) - Equivalence of PDAs and CFGs - Deterministic Pushdown Automata - Properties of Context Free Languages: Normal Forms for Context Free Grammars - Chomsky and Greibach normal forms - Pumping lemma for context-free languages - closure properties of CFLs

UNIT - III

19 Periods

Context-sensitive languages: Context-sensitive grammars (CSG) and languages - linear bounded automata and equivalence with CSG

Introduction to Turing machines: The Turing Machine (TM) - Church-Turing thesis Programming Techniques for Turing Machines – extensions to the Basic Turing Machine – Restricted Turing Machine - Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators

UNIT - IV

19 Periods

Undecidability: A Language That Is Not Recursively Enumerable (RE)- Diagonalization languages - An Undecidable Problem that Is RE - Universal Turing machine - undecidable problems about Turing Machines - Reductions between languages and Rice's theorem

Basic Introduction to Complexity: Intractable Problems - Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines – Classed P and NP, An NP- complete Problem - Cook's Theorem - Additional NP -Complete problems

TEXT BOOKS

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson, 3rd Edition, 2011.
2. Peter Linz, An Introduction to Formal Languages and Automata, Jones and Bartle Learning International, United Kingdom, 6th Edition, 2016.

REFERENCES

1. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson, 2015.
2. Michael Sipser, Introduction to the Theory of Computation, 2nd Edition, Thomson Course Technology, 2006.
3. John Martin, Introduction to Languages and the Theory of Computation, McGraw Hill Higher Education, 2007.
4. M. R. Garey and D. S. Johnson, Computers and Intractability, A Guide to the Theory of NP Completeness, W. H. Freeman & Co, 1990.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • List the properties of regular languages, design regular expressions and construct equivalent automata. • Identify and prove a language is regular or not
Unit II	<ul style="list-style-type: none"> • Design the context-free grammars for context-free languages, transform them into normal forms • Construct Push Down Automata for the equivalent context-free grammars • Examine the properties of CFL
Unit III	<ul style="list-style-type: none"> • Design Context Sensitive Grammars for Context Sensitive Languages • Design Turing Machine for simple and complex tasks • Describe different Turing Machine models
Unit IV	<ul style="list-style-type: none"> • Summarize Chomsky Hierarchy, and differentiate recursive & recursively enumerable languages • Describe concepts of computational complexity, unsolvable and undecidable problems.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Design an appropriate automaton for a given language
- Construct a grammar for a given language
- Examine the equivalence of Automata and Grammars
- Employ Pumping Lemma to find whether a language is not regular or a language is not Context Free
- Examine the properties of Languages
- Select appropriate Turing Machines for a given problem
- Describe concepts of computational complexity, unsolvable and undecidable problems

L	T	P	C
3	1	0	4

Course Code: CS E212

Semester: III

COMPUTER ORGANIZATION & ARCHITECTURE

Course Objective:

This course will help the learner to understand the basic digital logic circuits, computer architecture, the memory system and Input / Output organization of a computer system.

UNIT - I

15 Periods

Basics in Boolean logic and Combinational/Sequential Circuits: Digital Computers - Logic Gates - Boolean Algebra - Map Simplification - Combinational Circuits - Flip-Flop - Sequential Circuits. **Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. **Data representation:** Signed number representation, fixed and floating point representations, character representation. **Computer arithmetic:** Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Unsigned Numbers - Multiplication of Signed Numbers - Fast Multiplication - Integer Division - Floating-Point Numbers and Operations, IEEE 754 format.

UNIT - II

15 Periods

Instruction set architecture of a CPU: Memory Locations and Addresses - Memory Operations - Instructions and Instruction Sequencing - Addressing Modes - Assembly Language - Stacks - Subroutines - Additional Instructions - CISC Instruction Sets. **Introduction to x86 architecture:** The Intel IA-32 Architecture: Memory Organization - Register Structure - Addressing Modes - Instruction Set - Interrupts and Exceptions.

UNIT - III

15 Periods

CPU control unit design: Instruction Codes - Computer Registers - Computer Instructions - Timing and Control - Instruction Cycle - Memory-Reference Instructions - Input-Output and Interrupt - Design of Basic Computer - Design of Accumulator Logic. **Microprogrammed Control:** Control Memory - Address Sequencing- Microprogram Example - Design of Control Unit. **Pipelining:** Basic Concept - Pipeline Organization - Pipelining Issues - Data Dependencies - Memory Delays- Branch Delays - Superscalar Operation - Pipelining in CISC Processors. **Parallel Processors:** Hardware Multithreading - Vector (SIMD) Processing - Cache Coherence

UNIT - IV

15 Periods

Memory system: Basic Concepts - Semiconductor RAM Memories - Read-only Memories - Direct Memory Access - Memory Hierarchy - Cache Memories - Performance Considerations - Virtual Memory - Memory Management Requirements - Secondary Storage. **Basic Input/Output:** Accessing I/O Devices - Interrupts. **Input / Output Organization:** Bus Structure - Bus Operation - Arbitration - Interface Circuits - Interconnection Standards

TEXTBOOKS

1. M. M. Mano, Computer System Architecture, Prentice Hall of India, 3rd Edition, 2007.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann publishers, 5th Edition, 2014.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, Computer Organization and Embedded Systems, McGraw Hill, 5th Edition, 2012.

REFERENCES

1. John P. Hayes, Computer Architecture and Organization, McGraw-Hill, 2nd Edition, 1998.
2. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson India, 11th Edition, 2019.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Describe the background for understanding the digital circuits• Illustrates various data types represented in binary form and presents arithmetic algorithms
Unit II	<ul style="list-style-type: none">• Discuss the concepts of machine instructions, addressing techniques, and instruction sequencing and explores the X86 architecture
Unit III	<ul style="list-style-type: none">• Presents the organization and design of a basic digital computer and discuss the microprogramming concepts
Unit IV	<ul style="list-style-type: none">• Describe the memory hierarchy and explain the operation of cache memory• Explain the techniques that computers use to communicate with input and output devices

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Describe the background for understanding the digital circuits
- Illustrates various data types represented in binary form and presents arithmetic algorithms
- Discuss the concepts of machine instructions, addressing techniques, and instruction sequencing and explores the X86 architecture
- Presents the organization and design of a basic digital computer and discuss the microprogramming concepts
- Describe the memory hierarchy and explain the operation of cache memory
- Explain the techniques that computers use to communicate with input and output devices

L	T	P	C
3	0	0	3

Course Code: CS E213

Semester: III

OBJECT ORIENTED PROGRAMMING

Course objective: This course will help the learner to employ object oriented concepts for developing programs catering to different applications

UNIT - I

11 Periods

Procedural programming, An Overview of C: Types- Fundamental types, boolean, Character type, Integer types, Float types, prefixes and suffixes, void, Declarations-scope, Reference data types, Variables, Declared Constants, enumerated constants, the typecasting operator, Operator and Expressions, **Input and Output (C-way), Statements-** Statement Summary, Declarations as Statements, Selection Statements, Iteration Statements, goto Statements, **Pointers, Arrays, and References-** Pointers, arrays, pointers into arrays, pointers and const, Pointers and Ownership, References, **Functions** - Function Declarations, argument passing-reference argument, array arguments, overloaded functions, **Error handling, Namespaces, Preprocessor directive:** Trigraph sequence, Digraph Sequence, #define, #undef, #ifdef, #ifndef, #if, #endif, #else, #elif and #line

UNIT - II

11 Periods

Some difference between C and C++: Single line comments, Local variable declaration within function scope, function declaration, function overloading, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, Operator new and delete, Inline Functions in contrast to macro. **The Fundamentals of Object Oriented Programming:** Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object, **More extensions to C in C++ to provide OOP Facilities:** Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, **Error handling (exception)**

UNIT - III

12 Periods

Essentials of Object Oriented Programming: Operator overloading, Polymorphism- Overloading, **Class relationship-Inheritance** – Single and Multiple, Virtual and abstract base class, Friend class, Class Hierarchy, Inherited constructors, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, overriding and hiding, **Generic Programming: Template-**class template, function template, template specialization

UNIT - IV

11 Periods

Input and Output: Streams, Files, Library functions, formatted output. **Object Oriented Design and Modelling:** UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design

TEXT BOOKS

1. Bjarne Stroustrup, The C++ Programming Language, Pearson Addison-Wesley Professional, US, 4th Edition, 2013.
2. Debasish Jana, C++ and Object-Oriented Programming Paradigm, PHI Learning Pvt. Ltd., New Delhi, 3rd Edition, 2014.

REFERENCE BOOKS

1. Bjarne Stroustrup, Programming - Principles and Practice Using C++, Pearson Addison-Wesley Professional, US, 2nd Edition, 2014.
2. Bjarne Stroustrup, The Design and Evolution of C++, Pearson Addison-Wesley Professional, US, 1st Edition, 1994.

UNITWISE LEARNING OUTCOMES

After successful completion of the course the learner will be able to

Unit I	<ul style="list-style-type: none">• Illustrate the object-oriented concepts
Unit II	<ul style="list-style-type: none">• Apply the concepts of classes and objects for a given application
Unit III	<ul style="list-style-type: none">• Construct user defined data types with overloaded operators• Develop applications by making use of inheritance
Unit IV	<ul style="list-style-type: none">• Develop applications using file streams

COURSE OUTCOMES

Upon successful completion of this course, the learner will be able to

- Describe the object-oriented concepts and write programs using basic constructs and functions in C++
- Employ the concepts of classes and objects for a given application
- Create user defined data types and demonstrate operator overloading, inheritance, data conversion
- Use pointers and demonstrate memory management, virtual and friend functions
- Develop applications using file streams

L	T	P	C
3	0	0	3

Course Code: CSE214

Semester: III

COMPUTATIONAL STATISTICS

Course Objective: To provide learners with in-depth knowledge on various computational statistical techniques. The student will be able to design and implement machine learning algorithms for data analysis, clustering, regression and classification.

UNIT - I

11 Periods

Multivariate Normal Distribution: Multivariate Normal Distribution Functions - Conditional Distribution and its relation to regression model - Estimation of parameters. **Multiple Linear Regression Model:** Standard multiple regression models with emphasis on detection of collinearity - outliers - non-normality and autocorrelation - Validation of model assumptions.

UNIT - II

11 Periods

Multivariate Regression: Assumptions of Multivariate Regression Models - Parameter estimation - Multivariate Analysis of variance and covariance. **Discriminant Analysis:** Statistical background - Linear discriminant function analysis - Estimating linear discriminant functions and their properties.

UNIT - III

12 Periods

Principal Component Analysis: Principal components - Algorithm for conducting principal component analysis - Deciding on how many principal components to retain H-plot. **Factor Analysis:** Factor analysis model - Extracting common factors - Determining number of factors - Transformation of factor analysis solutions - Factor scores.

UNIT - IV

11 Periods

Cluster Analysis: Introduction, Types of clustering, Correlations and distances, Clustering by partitioning methods, Hierarchical clustering, Overlapping clustering, K-Means Clustering - Profiling and Interpreting Clusters.

TEXT BOOKS

1. Jobson, J. Dave, *Applied multivariate data analysis*, Vol, I & II, 2012, Springer-Verlag New York Inc.
2. Anderson TW, *An introduction to multivariate statistical analysis*, 3rd Edition, 2009, Wiley Publications.

REFERENCES

1. Mark Lutz, *Programming Python*, 4th Edition, 2010, O'Reilly Media.
2. Tim Hall and J-P Stacey, *Python 3 for Absolute Beginners*, 3rd Edition, 2009, Apress

3. Magnus Lie Hetland, *Beginning Python: From Novice to Professional*, 3rd Edition, 2005, Apress

UNITWISE LEARNING OUTCOMES

Unit I	The learner will have an understanding of the concepts of multivariate normal distribution and multiple linear regression models.
Unit II	The learner will have an understanding of the multivariate regression and discriminant analysis.
Unit III	The learner will have an understanding of the principal component and factor analysis.
Unit IV	The learner will be able to implement various clustering algorithms

COURSE OUTCOMES

Upon successful completion of this course, the learner will be able to

- Understand the multivariate normal distribution and apply multiple linear regression models
- Interpret multivariate regression and discriminant analysis
- Apply principal component and factor analysis for preprocessing
- Implement various clustering algorithms for different applications

L	T	P	C
3	0	0	3

Course Code: INT104

Semester: III

DATABASE MANAGEMENT SYSTEMS

Course Objectives:

This course will help the learner to infer the fundamentals of data models and to conceptualize and depict a database system using ER diagram. Construct tables and write effective queries to design and implement a database for real-world applications.

UNIT - I

11 Periods

Introduction: Database-System Applications - Purpose of Database Systems - Data Abstraction - Data Independence - Database system architecture - Structure of Relational Databases - Database Schema – Keys - Schema Diagrams - Relational Query Languages - Relational Operations

Data models: The Entity-Relationship Model – Constraints - Removing Redundant Attributes in Entity Sets - Entity-Relationship Diagrams - Reduction to Relational Schemas - Entity-Relationship Design Issues. Hierarchical Model - Network Model.

Storage strategies: Dense and Sparse Indices - Multilevel Indices - Secondary Indices - Structure of a B+-Tree - Queries on B+-Trees. **Hashing:** Hash Functions - Handling of Bucket Overflows - Hash Indices.

UNIT - II

11 Periods

Relational query languages: Overview of the SQL Query Language - SQL Data Definition - Basic Structure of SQL Queries - Additional Basic Operations - Set Operations - Null Values - Aggregate Functions - Nested Subqueries - Modification of the Database - Join Expressions – Views - Integrity Constraints.

Relational database design: Features of Good Relational Designs - Atomic Domains and First Normal Form - Keys and Functional Dependencies - Boyce–Codd Normal Form - BCNF and Dependency Preservation - Third Normal Form - Functional-Dependency Theory - Multivalued Dependencies - Fourth Normal Form - More Normal Forms.

UNIT - III

12 Periods

Query processing and optimization: Overview - Measures of Query Cost - Selections Using File Scans and Indices - Nested-Loop Join. **Query optimization:** Overview – Transformation of Relational Expressions.

Transaction processing: Transaction Concept - A Simple Transaction Model - Transaction Atomicity and Durability - Transaction Isolation – Serializability. **Concurrency Control:** Lock-Based Protocols - Implementation of Locking – **Deadlock:** Deadlock Prevention - Deadlock Detection - Recovery from Deadlock - Timestamps - The Timestamp-Ordering Protocol - Validation-Based Protocols - Multiversion Timestamp Ordering - Multiversion Two-Phase Locking - Failure Classification - Recovery Algorithm.

UNIT - IV

11 Periods

Database Security: Introduction to Database Security Issues, DAC, MAC and RBAC models, SQL injection.

Advanced topics: Object oriented and object relational databases: Complex Data Types - Structured Types and Inheritance in SQL - Type Inheritance. **Web databases:** Ranking Using TF-IDF - Similarity-Based Retrieval. **Distributed databases:** Homogeneous and Heterogeneous Databases - Data Replication - Data Fragmentation **Data warehousing and data mining:** Components of a Data Warehouse - Warehouse Schemas – Data Mining – classification - clustering

Case Study*: MYSQL, DB2, SQL server.

***Case studies are meant for comparison study only and not for end-semester examinations**

TEXT BOOKS

1. Henry F.Korth, Abraham Silberschatz, Sudarshan. *Database System Concepts*, McGraw Hill, 6th Edition, 2010.
2. R.Elmasri, S.B.Navathe. *Fundamentals of Database Systems*, Addison Wesley, 7th Edition, 2016.

REFERENCES

1. J. D. Ullman. *Principles of Database and Knowledge Base Systems*, Vol 1, Computer Science Press, 1988.
2. Serge Abiteboul, Richard Hull and Victor Vianu. *Foundations of Databases*. Addison Wesley, 1995

ONLINE MATERIALS

1. <https://nptel.ac.in/courses/106105175/1>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/>

COURSE LEARNING OUTCOMES

- Upon successful completion of this course, the learner will be able to
- Compare and contrast database systems from file systems and describe the fundamental elements of relational database management systems
- Construct ER models to represent simple database application scenarios and employ appropriate Storage Strategies.
- Build SQL queries for the given scenario
- Examine the normalization concepts to refine the database design
- Apply various concurrency control techniques in transaction processing system
- Outline the basic constructs in Advanced databases.

L	T	P	C
0	0	2	1

Course Code: CSE216

Semester: III

OBJECT ORIENTED PROGRAMMING LABORATORY

Course Objective: To help the learners understand the underlying concepts of C++ language and able to develop programs for various real time problems and computations

LIST OF EXPERIMENTS

1. Programs using Branching
2. Programs using Multi Dimensional Array
3. Programs using Function Overloading and Inline Functions, pass and return by reference
4. Programs using preprocessor directives
5. Programs using Classes and Objects (Array as Data Member and Array of Objects)
6. Programs using Constructors and Destructor
7. Programs using Operator Overloading
8. Programs using Inheritance
9. Programs using Virtual Functions and Friend Functions
10. Programs using Templates
11. Programs using Files
12. Programs using Exception Handling

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Apply overloading concepts for functions and inline functions.
- Create the user defined objects by creating classes with constructors
- Differentiate string in C and 'string' class in C++ and the built in functions to do operations on strings.
- Apply data conversion from one unit to another for both in built data types and user defined using overloading member functions
- Create base and derived classes and inherit the parent class properties along with virtual and friend functions
- Develop applications using file streams and multi files and templates

L	T	P	C
0	0	2	1

Course Code: CSE217

Semester: III

COMPUTATIONAL STATISTICS LABORATORY

Course Objective: To implement the core features of Python and to solve machine learning algorithms. This course will enable student to implement machine learning algorithms using various datasets.

LIST OF EXPERIMENTS

1. Write a Python program to implement stack and queue using list.
2. Write a Python program to read and write from a file.
3. Write a Python program to demonstrate bank saving account processing using constructors.
4. Write a Python program to calculate student mark grading using classes and objects.
5. Demonstrate the following plot using iris dataset
Line plot & Multiline plot
Bar chart & Pie Chart
6. Write a python program to demonstrate box plot and scatter plot using iris dataset.
7. Write a python program to demonstrate histogram using Wisconsin dataset.
8. Write a program to implement k-means algorithm to cluster a set of data using iris dataset.
9. Write a program to implement fuzzy c-means algorithm to cluster a set of data using iris dataset.
10. Apply PCA algorithm to find the principal components of a Wisconsin dataset.
11. Write a program to demonstrate the working of the linear discriminant analysis. Use an iris dataset to test the same.
12. Write a program to implement multiple linear regression using iris dataset.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Employ list, constructors, classes and histogram
- Perform file operations, create various plots using datasets
- Implement k-means, fuzzy c-means algorithm to cluster the data
- Apply the Principal Component Analysis for dimensionality reduction, Linear Discriminant Analysis and Linear Regression in solving classification problems

L	T	P	C
0	0	2	1

Course Code: INT105

Semester: III

DATABASE MANAGEMENT SYSTEMS LABORATORY

Course Objectives

This course will help the learner to build a strong formal foundation in Database Concepts, Technology with Practices and groom them into well-informed Database Application Developers.

1. SQL commands for table manipulation (Create, Alter, Drop Statements and Key Constraints)
2. SQL commands for data manipulation (Select, Insert, Update and Delete statements)
3. SQL queries using Arithmetic, Logical, Set Operations, Sorting and grouping Operations
4. SQL commands using built-in functions and nested queries
5. SQL commands using Joins (Inner and Outer Joins)
6. SQL queries for creating Index, Views, Sequences & Synonyms
7. Programs using simple PL/SQL construct
8. Programs for function and procedure Creation using PL/SQL
9. Programs using PL/SQL for cursor creation
10. Programs using PL/SQL to create triggers
11. Data handling application using C++
12. Develop CRUD application.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Build a table using SQL DDL commands
- Construct queries using SQL DML statements
- Apply integrity constraints on a database using a state-of-the-art RDBMS
- Develop Programs in PL/SQL including procedures and functions.
- Make use of Cursors and Triggers in PL/SQL.
- Utilize ODBC to Connect a Application with an Database

L	T	P	C
3	0	0	3

Course Code: CSE308

Semester: IV

OPERATING SYSTEMS

Course Objective: This course will help the learner to understand the modules of an operating system, their functions, process management techniques, scheduling algorithms, problems of concurrent processes and possible solutions, memory management strategies, file and IO system concepts.

UNIT - I

11 Periods

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads. using the tools of Matrices

UNIT - II

11 Periods

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.

Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware.

Solutions: Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dining Philosopher Problem, Barber's shop problem.

UNIT - III

11 Periods

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery

Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not-recently used (NRU) and Least Recently used (LRU).

UNIT - IV**12 Periods**

I/O Hardware: I/O devices, Device controllers, Direct Memory Access, Principles of I/O.

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

Case study: UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls.

TEXTBOOKS

1. Abraham Silberschatz, Peter Baer Galvin. And Greg Gagne. *Operating System Concepts* 9th Edition: Wiley, 2013.

REFERENCES

1. William Stallings. *Operating Systems: Internals and Design Principles* 9th Edition: Pearson, 2017
2. Charles Crowley, *Operating Systems: A Design Oriented Approach*, McGraw Hill, 2017
3. Achyut Godbole, and Atul Kahate, *Operating Systems* 3rd Edition, Tata McGraw, 2011
4. Maurice J. Bach, *Design of the Unix Operating Systems*, PHI, 1988

ONLINE MATERIALS

1. <https://nptel.ac.in/courses/106106144/2>
2. <https://www.youtube.com/user/MrKeerthikiran/search?query=operating+systems>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Discuss the concept of process and process management. • Summarize the states of processes. • Distinguish threads from processes and point out the advantages of threads over processes.
Unit II	<ul style="list-style-type: none"> • Demonstrate CPU scheduling algorithms. • Explain the synchronization problems and implement solutions for the classic problems of synchronization.
Unit III	<ul style="list-style-type: none"> • Describe the causes of deadlocks. • Differentiate the three solutions for deadlock handling. • Implement banker's algorithm for deadlock avoidance. • Demonstrate the memory management schemes and compare them.
Unit IV	<ul style="list-style-type: none"> • Analyze the performance of disk scheduling algorithms. • Appraise the concepts of file systems. • Summarize the concepts related to I/O systems. • Illustrate shell programming.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Understand the modules of an operating system and to recognize the services of operating systems.
- Experiment with different CPU scheduling algorithms in order to compare and analyzes their performances.
- Comprehend the causes and consequences of deadlocks and the possible options to tackle them.
- Learn the concepts of memory management and different memory partitioning techniques with their merits and demerits.
- Implement and compare various disk scheduling algorithms.
- Appraise the file organization and I/O techniques.

L	T	P	C
4	0	0	4

Course Code: CSE215
Semester: IV

SOFTWARE ENGINEERING

Course Objectives: This course will help the learner to develop real-time software projects in a systematic and methodical manner inclined by the phases of software engineering life cycle

UNIT - I

15 Periods

Introduction: The Nature of Software - Software Process - Engineering Practice - A Generic Process Model - Defining a Framework Activity - Identifying a Task Set. Process Patterns - Process Assessment and Improvement - Process Models: Prescriptive Process Models - Specialized Process Models - The Unified Process - Personal and Team Process Models - Agile Development – Software Team - Team Structures - Agile Teams - CMMI.

UNIT - II

15 Periods

Understanding Requirements & Software Estimation: Requirement Engineering - Establishing the Groundwork - Eliciting Requirements - Developing Use cases - Building the Analysis Model - Negotiating and Validating Requirements - Requirements analysis - Scenario-based modeling – UML models that supplement the Use Case – Identifying analysis classes - specifying attributes – defining operations – Class-Responsibility-Collaborator modelling, Associations and dependencies - Analysis packages – Creating a behavioral model – Identifying events with the use case – State representations - Estimation - Project Planning Process - Resources - Decomposition Techniques - Empirical Estimation Models - Estimation for OO Projects.

UNIT - III

15 Periods

Design Engineering: The Design Process - Design Concepts - The Design Model - Software Architecture - Architectural Genres - Architectural Styles - Architectural Considerations - Architectural Decisions – Architectural Design – Assessing Alternative Architectural designs - Traditional, Object-oriented, Process related View of Components - Designing Class-based Components - Conducting Component-Level Design - Component-based Development - The Golden Rules of User interface design - User Interface Analysis and Design - Interface Analysis & Design Steps - Design Evaluation.

UNIT - IV

15 Periods

Software Testing: Strategic Approach to software testing - Strategic Issues - Test Strategies for Conventional & Object-oriented Software - Validation Testing - System Testing - The Art of Debugging – Software testing fundamentals - Internal and External Views of Testing - White-Box Testing - Basis Path Testing - Control Structure Testing - Black-Box Testing - Model-based Testing - Testing Documentation - Testing for Real-Time Systems - Patterns for Software Testing - Testing OOA and OOD Models - Object oriented testing strategies - Object-Oriented testing methods - Testing methods applicable at the class level - Interclass Test-Case design.

TEXT BOOK

1. Roger S, Pressman and Bruce R, Maxim. *Software Engineering A Practitioner's Approach*, McGraw Hill, 8th Edition, 2015.

REFERENCES

1. Ian Sommerville, *Software Engineering*, Addison-Wesley, 10th Edition, 2015.
2. Pankaj Jalote. *An Integrated Approach to Software Engineering*, Narosa Publishing House, 3rd Edition, 2014.

ONLINE MATERIALS

1. <http://nptel.ac.in/courses/106101061/>
2. http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Soft%20Engg/New_index1.html

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Build software projects using different process models • Implement agile software process model
Unit II	<ul style="list-style-type: none"> • Dramatize the activities involved in analysing the requirements • Estimate LOC and FP based efforts in person/months • Design use case, data, class and behavioural models for the software
Unit III	<ul style="list-style-type: none"> • Illustrate architectural and component models • Create effective user interfaces
Unit IV	<ul style="list-style-type: none"> • Test software code based on functional and non-functional aspects of the software • Prepare test plans and strategies for conventional and OO software

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course Outcome	Knowledge Level
1	Choose an appropriate process model for software product requests and construct agile software process model for a given scenario	K2
2	Elucidate the stakeholder's requirements and employ the models for analysing the requirement	K2
3	Estimate software cost and efforts in person/months	K4
4	Construct Use cases, Activity, Collaboration and state transition diagrams that maps software requirements	K6
5	Design architecture for developing a project based on user requirements	K6
6	Create test plans and employ testing strategies for verifying functional and non-functional requirements of the project	K5

L	T	P	C
3	0	0	3

Course Code: CSE318
Semester: IV

ALGORITHM DESIGN STRATEGIES & ANALYSIS

Course Objectives

This course will help the learner to acquire knowledge to develop efficient algorithm for a given application by selecting appropriate design technique and analyze its computational complexity

UNIT - I

11 Periods

Introduction: Algorithm Specification - Performance Analysis - Space Complexity, Time Complexity - Asymptotic Notation (O , Ω , Θ) - Time and Space Trade-Offs - Analysis of Recursive Algorithms through Recurrence Relations - Substitution Method - Recursion Tree Method - Masters' Theorem **Fundamental Algorithmic Strategies:** Brute-Force Method - Heuristics Method - Travelling Salesman Problem - Greedy Method - General Method - Knapsack Problem - Job Sequencing with Deadlines

UNIT - II

11 Periods

Advanced Strategies: Dynamic Programming Method - Optimal Binary Search Trees - String Editing - 0/1 Knapsack - Travelling Salesman problem - Branch and Bound Method - 0/1 Knapsack Problem - Travelling Salesman Problem - Backtracking Method - 8-Queens Problem - Sum of Subsets - Hamiltonian Cycles - Knapsack Problem

UNIT - III

11 Periods

Graph and Tree Algorithms: Traversal algorithms - Breadth First Search - Depth First Search - Topological sort - Minimum Spanning Tree - Kruskal's and Prim's - Shortest path algorithms - Bellman Ford Algorithm - Dijkstra's Algorithm - Floyd-Warshall Algorithm - Flow Networks - Ford-Fulkerson Method

UNIT - IV

12 Periods

Tractable and Intractable Problems: Nondeterministic Algorithms - The classes NP-Hard and NP-Complete - Cook's Theorem - Clique Decision Problem - Node Cover Decision Problem - Travelling Salesperson Decision Problem. **Advanced Topics:** Approximation algorithms - Scheduling Independent Tasks - Bin Packing - Interval Partitioning - Randomized algorithms - Class of problems beyond NP - P SPACE - Introduction to Quantum Algorithms

TEXTBOOK

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, *Fundamental of Computer Algorithms*, Computer Science Press, Second Edition, 2008.
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein. *Introduction to Algorithms*, Prentice Hall of India, Third Edition, 2009. (Paperback-2011)
3. A.V. Aho, J.E. Hopcroft, and J.D. Ullman. *The Design and Analysis of Computer Algorithms*, Pearson Education, 2003.

REFERENCES

1. Anyan Levitin. *Introduction to the Design and Analysis of Algorithm*, Pearson Education,

Third Edition, 2012.

2. Sara Baase and Allen Van Gelder. *Computer Algorithms - Introduction to Design and Analysis*, Pearson Education, Third Edition, 2008.
3. Jon Kleinberg and Éva Tardos. *Algorithm Design*, Pearson Education, First Edition, 2013.

ONLINE MATERIALS

1. https://onlinecourses.nptel.ac.in/noc21_cs68/preview
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Define asymptotic notations for time complexity analysis• Employ the techniques for solving recurrences to find the computational complexity of recursive algorithms• Develop algorithms using Brute-Force, Heuristic and Greedy Strategies
Unit II	<ul style="list-style-type: none">• Develop algorithms using Dynamic Programming, Branch and Bound and Backtracking strategies for a given application
Unit III	<ul style="list-style-type: none">• Judge and Select appropriate graph algorithms for a given application
Unit IV	<ul style="list-style-type: none">• Define computability classes - P, NP, NP-Complete and NP-Hard• Employ approximation algorithms for solving NP-Complete and NP-Hard problems.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Define asymptotic notations for time complexity analysis
- Employ the techniques for solving recurrences to find the computational complexity of recursive algorithms
- Judge and Select appropriate design strategy (Brute-Force, Heuristic, Greedy, Dynamic Programming, Branch & Bound and Backtracking) for solving a given application
- Judge and Select appropriate graph algorithms for a given application
- Define computability classes - P, NP, NP-Complete and NP-Hard
- Employ approximation algorithms for solving NP-Complete and NP-Hard problems

L	T	P	C
3	0	0	3

Course Code: MGT207

Semester: IV

INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP

Course Objectives:

The major emphasis of the course will be on creating a learning system through which management students can enhance their innovation and creative thinking skills, acquaint themselves with the special challenges of starting new ventures and use IPR as an effective tool to protect their innovations and intangible assets from exploitation.

As a part of this course, students will:

- Learn to be familiar with creative and innovative thinking styles
- Learn to investigate, understand and internalize the process of founding a startup
- Learn to manage various types of IPR to protect competitive advantage

UNIT - I

10 Periods

Innovation: Introduction – Importance of Innovation – Definitions – Types of Innovation: Recognising innovation in products and services; processes and procedures; management practices; marketing and distribution strategies and techniques – Characteristics of Innovation: Timing; Radicalness; speed – Knowledge Management: Internal Knowledge generation – Importing knowledge from outside - Class Discussion- Is innovation manageable or just a random gambling activity?

UNIT - II

12 Periods

Building an Innovative Organization: Creativity in organizations – Building organizational environment – Need Analysis: Questionnaires, Online tools, SWOT analysis; Technology watch; Focus group; Desk Research – Innovation Management Process – stages of innovation - planning and financing Innovation projects – Innovation and organization: Creating new products and services, Exploiting open innovation and collaboration, Use of innovation for starting a new venture; Class Discussion- Innovation: Co-operating across networks vs. 'go-it-alone' approach

UNIT - III

11 Periods

Entrepreneurship: Opportunity recognition and entry strategies – Effectuation – Design thinking – Lean Start-up – Developing Business Model – Entrepreneurship as a Style of Management – value proposition - Maintaining Competitive Advantage - Financial Plan: Start up, operating and variable costs and Project appraisal: NPV, IRR, BCR techniques - Projections and Valuation Stages of financing: Debt, Venture Capital and other forms of Financing. Entrepreneurship- Financial Planning: Break even analysis: Profit volume ratio, selling price determination, cash flow statement analysis, Ratio analysis

UNIT - IV

12 Periods

Intellectual Property Rights: Introduction and the economics behind development of IPR: Business Perspective - IPR in India – Genesis and Development - International Context - Use of IPR to protect Innovation - Concept of IP Management, Use in marketing Patent- Procedure, Licensing and Assignment, Infringement and Penalty - Trademark- Use in marketing, example of

trademarks- Domain name - Geographical Indications- What is GI, Why protect them? - Copyright- What is copyright - Industrial Designs- What is design? How to protect? Class Discussion- Major Court battles regarding violation of patents between corporate companies

TEXT BOOKS

4. Joe Tidd, John Bessant. *Managing Innovation: Integrating Technological, Market and Organizational Change*, University of Sussex, 2013
5. Case Study Materials: To be distributed for class discussion

REFERENCES

1. Hisrich, *Entrepreneurship*, Tata McGraw Hill, New Delhi, 2010.
2. Borut Likar and Peter Fatur, *Innovation Management*, 2013.
3. Andrew Metrick and Ayako Yasuda, *Venture Capital & The Finance of Innovation*, Wiley, 2011

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	The learner will be able to understand the basics of Innovation and the knowledge, source of innovation.
Unit II	The learner will be familiar about importance of innovation in an organization environment, stages of innovation while creating new products and services.
Unit III	The learner will be able to understand the role of entrepreneurs in opportunity discovery and analyse the business idea from finance dimension.
Unit IV	The learner will gain knowledge about the legal protection on patents and designs and other innovation as per the IPR Act.

COURSE OUTCOMES

Upon successful completion of the course, the learner will be able to

- Understand the basics of Innovation and the source of innovation
- Know the importance of innovation in an organization environment and the stages while creating new products and services.
- Understand the role of entrepreneurs in opportunity discovery and analyse the business idea
- Gain knowledge about the legal protection on patents and designs as per the IPR Act

L	T	P	C
3	0	0	3

Course Code: ENG212

Semester: IV

BUSINESS COMMUNICATION & VALUE SCIENCE - III

Course Objectives:

The course enables the Engineering students to develop technical writing skills in their courses and in their careers. It also introduces the students to Self-analysis techniques like SWOT & TOWS and also to the key concepts of Pluralism & cultural spaces, Cross-cultural communication, Science of Nation building

UNIT - I

10 Periods

SWOT and Motivation in Real Life Scenarios: SWOT and Life Positions; Create your SWOT; SWOT Vs. TOWS – The Balancing Act; Presentation on the strengths identified to survive in the VUCA World; Motivation; identifying and leveraging motivation; Maslow's Theory.

UNIT - II

12 Periods

Pluralism in Cultural Spaces: Rivers of India; Awareness and respect for pluralism in cultural spaces; Rhythms of India (Cultures in India) ; Global, glocal, translocational, Debate on Global, glocal, tanslocational impacts; Cross-cultural communication; Verbal and non-Verbal, Communication on Culture; Implications of cross cultural communication; Culture shock; Gender awareness - Gender awareness campaign.

UNIT - III

8 Periods

Role of Science in Nation Building: Role of science in nation building; the role of scientists and mathematicians from ancient India through augmented reality. Role of science post- independence; Introduction to technical writing; Basic rules of technical writing through examples; technical writing in real-life scenarios

UNIT - IV

10 Periods

Definition AI (artificial intelligence Voice of the Future; AI in Everyday Life; Importance of AI: Design your college in the year 2090; Communicating with machines; Applying technical writing in profession; Scenario-based Assessment on technical writing

Project: Rural area visit / a practical technology solution to the issues prevail.

10 hours

TEXT BOOK:

There are no prescribed texts for Semester 4 – there will be handouts and reference links shared.

REFERENCES:

1. Examples of Technical Writing for Students
<https://freelance-writing.lovetoknow.com/kinds-technical-writing>
2. 11 Skills of a Good Technical Writer
<https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/>
3. 13 benefits and challenges of cultural diversity in the workplace
<https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/>

ONLINE RESOURCES

1. <https://youtu.be/CsaTslhSDI>
2. https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Apply SWOT in real life scenarios.
Unit II	<ul style="list-style-type: none">• Respect pluralism in cultural spaces.• Recognize the roles and relations of different genders
Unit III	<ul style="list-style-type: none">• Apply the science of Nation building• Apply technical writing in real-life scenarios
Unit IV	<ul style="list-style-type: none">• Recognize the importance of AI.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Understand, analyze & leverage the power of motivation in real life
- Understand and apply the concepts of Global, local and translocational
- Identify the common mistakes made in cross-cultural communication
- Recognize the roles and relations of different genders.
- Understand Artificial intelligence & recognize its impact in daily life
- Identify the best practices of technical writing
- Differentiate the diverse culture of India

L	T	P	C
2	1	0	3

Course Code: MAT330
Semester: IV

OPERATIONS RESEARCH

Course Objectives:

To help the learners understand the concepts of LPP, underlying principles of various techniques available to solve linear, nonlinear, network, inventory and queuing models.

UNIT - I

15 Periods

Introduction to OR and LPP: Concept of optimization - Linear programming - formulation, solution by graphical and simplex methods (Primal - Penalty- big-M method), Special cases.

UNIT - II

10 Periods

Transportation and Assignment problems: Transportation Problem - simple problems - NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution. Assignment problems - Hungarian, test for optimality (MODI method), degeneracy & its resolution. CPM and PERT networks - Critical path scheduling - Sequencing models.

UNIT - III

10 Periods

Inventory Control and Simulation: Inventory models - Economic order quantity models - Quantity discount models - Stochastic inventory models - Multi product models - Applications of simulation techniques in inventory control system.

UNIT - IV

10 Periods

Queuing Theory: Queuing Theory - single and Multi-channel models - Infinite number of customers and infinite calling source. Replacement Models - Individuals replacement Models (With and without time value of money) - Group Replacement Models. Applications of simulation techniques in queuing system.

TEXT BOOK:

1. H.A. Taha, Operations Research: An Introduction, 8th Edition, Pearson Inc, New Jersey, 2006

REFERENCE BOOKS:

1. K.G. Murthy, Linear Programming, Wiley, 1983.
2. G. Hadley, Linear Programming, Narosa Publishing House, 1994.
3. F.S. Hiller and G.J. Lieberman, Introduction to Operations Research, McGraw Hill, 9th Edition, 2011.

ONLINE MATERIALS

1. NPTEL - <http://nptel.ac.in/courses/111104071/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	Have an understanding of the concepts and different methods of solution of linear programming problem
Unit II	Apply different techniques to find the optimization from source to sink and solution of shortest path
Unit III	Apply different techniques to find the inventory Control and Simulation models.
Unit IV	Analyze different techniques involved in solving the Queuing Theory and Simulation models.

Course Learning Outcomes

Upon successful completion of the course, the learner will be able to:

- Learn efficient computational procedures to solve optimization problems.
- Cast engineering minima/maxima problems into optimization framework.
- Recognize the importance and value of Optimization Techniques in solving practical problems in industry
- Develop Optimization models and apply them to real life problems
- Design new models to improve decision making and develop critical thinking and objective analysis of decision problems

L	T	P	C
0	0	2	1

Course Code: CS
Semester: IV

OPERATING SYSTEMS LABORATORY

Course Objective:

This course will help the learner to explore inter-process communication mechanisms and simulate CPU, file and Disk scheduling algorithms and to implement memory management techniques

1. Creation of a child process using fork system call and communication between parent and child using pipe.
2. Simulation of IPC through shared memory and message queues.
3. Simulation of CPU scheduling algorithms and analyzing their performances.
4. Simulation of thread scheduling approaches.
5. Implementing the solution for Producer-Consumer problem for the bounded and unbounded buffer variants.
6. Implementing the solution for Reader-Writer problem based on reader priority and writer priority approaches.
7. Simulation of Banker's algorithm for Deadlock Avoidance.
8. Simulation of Deadlock Detection.
9. Implementing a solution to resolve the Dining Philosopher's problem.
10. Simulation of memory allocation schemes based on dynamic partitioning with placement algorithms and buddy systems.
11. Simulation of page replacement algorithms.
12. Implementing the address translation mechanism under paging.

COURSE LEARNING OUTCOMES

- Upon successful completion of this course, the learner will be able to
- Create parent and child processes.
- Implement sender-receiver processes that carry out IPC using shared memory and message queue.
- Demonstrate CPU scheduling algorithms and compare their performance.
- Illustrate thread scheduling approaches.
- Implement the solution for classic problems for synchronization using semaphore.
- Analyze the two deadlock solutions.
- Compare the memory partitioning and allocation techniques.

L	T	P	C
0	0	2	1

Course Code: CSE218

Semester: IV

SOFTWARE ENGINEERING LABORATORY

Course Objective: This course will help the learner to accustom the steps and utilities of various tools available for software engineering process and practices.

LIST OF EXPERIMENTS

1. CASE Tools Study: Study of Rational Unified Process
2. Prepare Software Requirement Specification (SRS) Report
3. Design Use case and Activity Diagrams
4. Draw Sequence, Collaboration and Class Diagram
5. Demonstrate Forward and Reverse Engineering for JAVA programs
6. Execute Memory Leak Testing
7. Perform Code Coverage Testing
8. Prepare Automated Test Plans
9. Create Manual Test Scripts
10. Build Test Scripts for Object Insertions and Alphanumeric Verification Points
11. Generate Test Scripts to receive inputs from External Data Sources & Data Pools
12. Implement Test Scripts for Website Testing

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Identify use cases and map them to the corresponding software features.
- Prepare software requirement specification document in Rational Requisite Pro.
- Create use case, activity, sequence, collaboration and class diagrams.
- Employ Rational Purify and Pure Coverage tools to perform black box and memory leak testing for the code.
- Execute Rational Quantify to identify the portions of your application that dominates the execution time.
- Construct test plans to write manual and automatic test cases using Rational Robot and Test Manager.

L	T	P	C
0	0	2	1

Course Code: CSE319
Semester: IV

ALGORITHM DESIGN STRATEGIES & ANALYSIS LABORATORY

Course Objectives

This course will help the learner to select appropriate algorithm and design technique for a given application

1. Applications of Heuristic Method - Travelling Salesman Problem
2. Applications of Greedy Method - Knapsack, Job Sequencing with Deadlines
3. Applications of Dynamic Programming - Optimal Binary Search Trees, 0/1 Knapsack
4. Applications of Branch & Bound - Travelling Salesman Problem, 0/1 Knapsack
5. Applications of Backtracking- 8 Queens Problem, Sum of subsets
6. Programs on Graphs - Topological Sort of Directed Acyclic Graph
7. Programs on Graphs - Minimum Spanning Tree using Prim's and Kruskal's algorithms
8. Programs on Graphs - Single Source Shortest paths using Bellman-Ford algorithm
9. Programs on Graphs - All-Pairs Shortest Paths using Floyd-Warshall algorithm
10. Programs on Graphs - Maximum Flow using Ford Fulkerson Method

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Employ Heuristic and Greedy strategies for optimization problems having greedy choice property
- Employ Dynamic Programming strategy for solving optimization problems having optimal substructure property and overlapping sub-problem property
- Employ Branch & Bound and Backtracking strategies for optimization problems with reducing the problem search space
- Employ graph algorithms for routing and other applications

L	T	P	C
0	0	2	1

Course Code: MS

Semester: IV

OPERATIONS RESEARCH LABORATORY

Course Objectives:

To help the learners to understand the various techniques available to solve linear, nonlinear, network, inventory and queuing models using R / Python Programme.

1. Graphical solution of LPP
2. Simplex and Big M methods in LPP
3. Two phase LP problems.
4. Dual and primal LP problems.
5. Implementing problems on Sensitivity Analysis.
6. Transportation problems.
7. Exercise problems Assignment problems.
8. Develop and solving problems on Queuing theory.
9. Estimation of Inventory model.
10. Exercise on Replacement theory.
11. Design and solve problems on PERT.
12. Solve problems on CPM.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Solve linear programming problem by graphical solution, simplex method and big M method, Two phase LP problems, Dual and primal LP problems.
- Analyze the Sensitivity Analysis.
- Solve the Transportation problems, Assignment problems, Queuing theory
- Solve the Inventory model and Replacement theory, PERT and CPM

L	T	P	C
3	0	0	3

Course Code: CSE316

Semester: V

SOFTWARE DESIGN WITH UML

Course Objectives:

This course will help the learner to understand the concepts of object-oriented technologies and unified modeling language to design the software in the aspects of interactions between use-cases, classes, packages, states, components, and execution architecture.

UNIT - I

11 Periods

Introduction. Software development process: The Waterfall Model vs. The Spiral Model. The Software Crisis, description of the real world using the Objects Model, Quality software characteristics. **Object oriented technologies:** Classes, inheritance and multiple configurations. Description of the Object- Oriented Analysis process vs. the Structure Analysis Model. The process of Object-oriented software development. Description of Design Patterns. Technological Description of Distributed Systems. **UML Language:** Standards - Elements of the language - General description of various models.

UNIT - II

12 Periods

Requirements Analysis Using Case Modeling. Analysis of system requirements. Actor definitions - Writing a case goal - Use Case Diagrams -Use Case Relationships.

Interaction diagrams (Transfer from Analysis to Design in the Characterization Stage). Description of goal - Defining UML Method, Operation, Object Interface, Class. **Sequence Diagram.** Finding objects from Flow of Events - Describing the process of finding objects using a Sequence Diagram - Describing the process of finding objects using a Collaboration Diagram.

UNIT - III

11 Periods

The Static Structure Diagrams (The Logical View Design Stage). The Class Diagram Model - Attributes descriptions - Operations descriptions - Connections descriptions in the Static Model. - Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity.

Package Diagram Model. Description of the model - White box, black box - Connections between packages – Interfaces - Create Package Diagram - Drill Down.

UNIT - IV

11 Periods

State Diagram / Activity Diagram (Dynamic Model). Description of the State Diagram - Events Handling - Description of the Activity Diagram - Exercise in State Machines.

Component Diagram Model. Physical Aspect - Logical Aspect - Connections and Dependencies - User face-Initial DB design in a UML environment.

Deployment Model. Processors – Connections – Components – Tasks – Threads - Signals and Events.

TEXTBOOKS

1. Bernd Bruegge and Allen H. Dutoit, *Object-Oriented Software Engineering: using UML, Patterns and Java*, Pearson publishers, 3rd Edition, 2011.
2. Martin Fowler, *UML Distilled*, Addison-Wesley Professional, 3rd edition, 2018.

REFERENCE

4. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley Professional, 1st Edition, 1995.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Explain the software development process models and object-oriented technologies• Describe the standards and elements of the unified modelling language used for different models
Unit II	<ul style="list-style-type: none">• Prepare software requirements specification document for a given problem• Represent the relationships between the use-cases using diagrams• Design the interaction between the use-cases using sequence diagrams
Unit III	<ul style="list-style-type: none">• Depict the classes with attributes and operations and establish the relationship between them• Combine the classes as packages and design the interactions between the as a diagram
Unit IV	<ul style="list-style-type: none">• Model the system based on the activities and number of states• Draw component diagram and deployment diagram for the system under study

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Describe the basics of software development process models, object-oriented technologies for software development and unified modelling language
- Analyse the requirements for the given problem to depict the relationship between the use-cases
- Depict the interaction between the use-cases as sequence diagrams
- Find the analysis classes with attributes and operations and establish the relationship between these classes
- Combine classes as packages and depict the interaction between these packages
- Model the system based on activity, number of states, physical & logical components, and deployment environment

L	T	P	C
3	0	0	3

Course Code: CSE320

Semester: V

COMPILER DESIGN

Course Objective:

This course will help the learner to explain various phases in translating source language to target language construct scanner and parser, intermediate code generation and identify the opportunities for optimization.

UNIT - I

11 Periods

Introduction: Languages Processors – Structure of Compiler – Applications of Compiler Technology – Programming Language basics - **Lexical Analysis:** Role of Lexical Analyzer - Input Buffering- Specifications and recognition of tokens – Lexical – Analyzer generator Lex- Finite Automata – From regular expressions to Automata – Design of a Lexical Analyzer Generator – Optimization of DFA Based pattern.

UNIT - II

11 Periods

Syntax Analysis – Introduction – Context Free grammars - Writing a Grammar – Top Down Parsing – Bottom up parsing – Simple LP – Canonical LR parsers – Parsers generators YACC
Symbol Table - Basic structure – use of Symbol table.

UNIT - III

12 Periods

Syntax Directed Translation: Syntax Directed Definitions – Evaluation orders for SDD's - Applications of Syntax Directed translation – Syntax Directed Translation Schemes **Intermediate Code generation:** Variants of Syntax trees – Three Address code – types and Declarations – Translation of Expression – Type Checking - **Runtime Environments:** Stack allocation of space – Access to Non local Data on the stack – Heap Management.

UNIT - IV

11 Periods

Code Generation: Issues in code generator – Basic Blocks and Flow graphs – Optimization for Basic Blocks – Peephole Optimization – Register Allocation and assignment – Machine Independent Optimizations: Principal Sources of optimization - Introduction to Data flow analysis – Foundation of Data Flow analysis.

TEXTBOOKS

1. Alfred V.Aho, Ravi Sethi, Jeffrey D. Ullman, Monica S. Lam. *Compilers: Principles, Techniques and Tools*, Pearson Education, Second Edition, 2006.
2. Levine, John R., Tony Mason, and Doug Brown. *Lex & yacc*, O'Reilly Media, Inc., Second Edition, 2013.

REFERENCES

1. Dick Grune, Kees Van Reewijk, Henry E.Bal, C. J.H. Jacobs, Koen G. Langendoen, *Modern Compiler Design*, Springer, Second Edition, 2012.

2. Das, Vinu V. *Compiler Design using FLEX and YACC*, Prentice Hall of India Learning Pvt.Ltd, 2007.
3. Keith D.Cooper and Linda Torczon. *Engineering a Compiler*, Morgan Kauffman Publishers, Second Edition, 2013.

ONLINE MATERIALS

1. <http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/compiler-desing/ui/TOC.html>
2. <http://nptel.ac.in/courses/106108052/>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Describe the phases of compiler• Design and develop scanners using Lex
Unit II	<ul style="list-style-type: none">• Construct LL and LR parsers• Use of Symbol table in all phases of compiler
Unit III	<ul style="list-style-type: none">• Describe the significance of attribute grammars• Development of intermediate code generation
Unit IV	<ul style="list-style-type: none">• Design dependent code generation• Identify the different techniques for code optimization for compiler construction• Elucidate the register allocation process in the backend phase of a compiler

COURSE LEARNING OUTCOMES

Upon successful completion the course, the learner will be able to

- Demonstrate the scanner construction from using Lex
- Develop parser using Lex & YACC
- Apply context sensitive analysis for type Inferencing
- Construct intermediate code representation for a given source code
- Identify appropriate techniques for code optimization
- Explain about the code generation and register allocation components in the backend phase of a compiler

L	T	P	C
3	1	0	4

Course Code: MGT132

Semester: V

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

Course Objectives

This course will teach students the management theories, evolution of management over the years, and few basic concepts of organizational design. After studying this course, the students will understand organizational work practices and various dimensions of employee behavior. The students will also grasp the intricacies of organizational structural impact on functional management areas such as finance, marketing, and strategy.

UNIT - I

15 Periods

Management Theories: Concept and Foundations of Management- Evolution of Management- Contribution of Management Thinkers: Taylor- Fayol- Elton Mayo etc. Key Managerial Role. Functions of Management- Planning- Organizing- Staffing- Directing- Controlling-Process and Tools- Decision Making & Problems in Decision Making- Ethics Corporate Social Responsibility - Overview of Corporate Governance

UNIT - II

15 Periods

Organizational Design: Dimensions of Organization Design : Classical- Neoclassical and Contingency approaches to organizational design- Organizational structure :Simple Structure- Functional Structure- Divisional Structure- Matrix Structure- Virtual Network Structure- & Hybrid Structure- Organizational Life Cycle.

UNIT - III

15 Periods

Fundamentals of Organizational Behaviour : OB- an overview- Foundations of Individual Behaviour :Personality- Perception- Learning and Reinforcement- Work place emotions and Attitudes -Motivation- Foundations of Group behaviour and Group Dynamics- Types of Teams - Team decision making methods- Basic approaches to Leadership and its applications

UNIT - IV

15 Periods

Organizational Processes: Emerging trends in Conflict- Power and Politics- Work Stress and Stress Management- Organizational Culture: Elements- Merging Cultures- Managing Cultural & Workforce Diversity- Organizational socialization.

TEXTBOOKS

1. Richard L. Daft, *Understanding the Theory and Design of Organizations*, Eleventh Edition, Cengage Learning, 2020

REFERENCES

1. Stephen Robbins, David De Cenzo, Mary Coulter, *Fundamentals of Management*, Global Edition, Eighth Edition, Pearson Education, New Delhi, 2012.
2. James A. F. Stoner, R. Edward Freeman, Daniel R. Gilbert, *Management*, Pearson Education, Sixth Edition, New Delhi, 2007.

3. Steven .L. Mcshane, Von Glinow, Radha.R.Sharma. M. A., *Organizational Behavior*, Tata McGraw-Hill, New Delhi, 2008
4. L.M.Prasad, *Organisational Behavior*, Sultan Chand & Sons, Fifth edition, 2014
5. Robins, S.P., Judge,Timothy.A., *Organizational Behavior*, PHI, Thirteenth Edition, 2013

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• understand the evolution and basic concepts of management and its functions
Unit II	<ul style="list-style-type: none">• understand the impact of different types of organizational design and structure.
Unit III	<ul style="list-style-type: none">• comprehend various factors that influence the individual behaviour and group behaviour in the organisation
Unit IV	<ul style="list-style-type: none">• understand the importance of organization culture and organizational processes

COURSE LEARNING OUTCOMES

Upon successful completion the course, the learner will be able to

- understand the evolution and basic concepts of management and its functions
- comprehend the individual behaviour and the factors that impact the organizational culture
- understand the impact of different types of organizational structures and their impact on performance
- understand the impact of ethics and corporate social responsibility on the various functional aspects of management
- comprehend the importance of different types of leadership

L	T	P	C
3	0	0	3

Course Code: MGT133

Semester: V

BUSINESS STRATEGY

Course Objective:

This course helps the learner to understand and employ the concepts, tools & techniques used by executives in developing and executing strategies and appreciate its integrative and interdisciplinary nature. It also helps the learner to develop the capability of making their own decisions in dynamic business landscape by developing their capacity to think & execute strategically.

UNIT - I

11 Periods

Introduction to Strategic Management: Strategic Management-Features, Values, Vision & Mission Statements-Objectives and Goals, strategic Intent, Types of strategies, Strategic management process, Methods of crafting strategies-- Intended and Emergent Strategies.

UNIT - II

11 Periods

Scanning the Environment for Competitive Advantage: Core Competence as the Root of Competitive Advantage, Scanning and monitoring general environment, PESTLE Analysis, SWOT Analysis, internal and external factor analysis matrix.

UNIT - III

11 Periods

Business level and Corporate level strategy: Five Forces of Industry Attractiveness that Shape Strategy, The concept of Strategic Groups, and Industry Life Cycle, Porter's, Value Chain analysis, Business Level strategy, Porter's Generic Competitive strategies, Functional Level Strategy.

UNIT - IV

12 Periods

Corporate Level Strategy and Strategy Implementation: Corporate Level Strategy - Growth Strategies, Diversification Strategies- Related and Unrelated diversification -Corporate Portfolio Analysis: BCG Matrix, GE Matrix, Types of international strategy, Entry mode strategies -Strategic Alliances. Implementing strategy - 7-S framework, Designing Strategic Control Systems.

TEXTBOOKS

1. Robert M. Grant, *Contemporary Strategic Management*, Blackwell, 7th Edition, 2012.
2. Azhar Kazmi, *Business Policy and Strategic Management*, Tata McGraw Hill, New Delhi, 3rd edition, 2008.
3. Thomas L. Wheelen, J. David Hunger, *Strategic Management and Business Policy*, AddisonWesley, 13th Edition, 2012.

REFERENCES

1. Pearce and Robinson, *Strategic Management*, Tata McGraw Hill Publishing Company Ltd, New Delhi, 12th Edition, 2012.

2. Charles W. L. Hill and Gareth R. Jones, *Strategic Management Theory*, An Integrated approach, Houghton Mifflin Company, Princeton New Jersey, All India Publisher and Distributors, Chennai, 2005.
3. Johnson and Scholes, *Exploring Corporate Strategy*, Pearson Education, New Delhi, 7th Edition, 2006.
4. Michael E. Porter, *Competitive Strategy*, The Free Press, New York, 1980
5. *Competitive Advantage*, 1985 Richard Rumelt (2011).

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">understand the basics of strategic management.
Unit II	<ul style="list-style-type: none">evaluate the influence of the external and internal factors in strategic analysis.
Unit III	<ul style="list-style-type: none">understand the business level and functional level strategy
Unit IV	<ul style="list-style-type: none">understand corporate level strategies, implementation and control of strategies.

COURSE LEARNING OUTCOMES

Upon successful completion the course, the learner will be able to

- understand the basics of strategic management
- evaluate the influence of the external and internal factors in strategic analysis
- make industry analysis and understand an organization's strengths, weaknesses, opportunities and threats
- allocate resources efficiently at the corporate level
- gain exposure to the factors for the successful implementation of the strategies

L	T	P	C
2	1	0	3

Course Code: ENG315**Semester: V****DESIGN THINKING****Course Objectives**

This course helps the learners to recognize the importance of Design Thinking (DT), explain the phases in the DT process, list the steps required to complete each phase in the DT process, apply each phase in the DT process, use doodling and storytelling in presenting ideas and prototypes, create value proposition statements as part of their presentations, examine closely how DT can help in functional work, analyse ways in which Agile and DT complement each other to deliver customer satisfaction

UNIT - I**11 Periods**

Introduction to Design Thinking: The importance of Design Thinking (DT) for individuals and business - the steps in the DT process-How to empathise? - The steps in the 'empathize' phase of DT; Introduction to immersion activity - the steps required to conduct an immersion activity.

UNIT - II**11 Periods**

Creating Personas: Creating personas - the steps to create personas in the define phase of DT - Problem statements: Definitions - the steps to create problem statements in the define phase of DT - the steps in the ideate phase of DT - Stages in Design thinking.

UNIT - III**11 Periods**

Ideation: How to ideate? - Ideation Games - Ideate to find solutions - Doodling - how it can help in presenting ideas during ideate and prototype phases - the importance of the prototype phase in DT - Creating a prototype - Storytelling in DT.

UNIT - IV**12 Periods**

Prototypes on Design Thinking: Recognize the importance of service value proposition - Creating a value proposition statement - Recognizing the best practices of the testing phase in DT - Importance of Prototype in Design Thinking - prototype your idea - Value proposition statement - Testing a prototype created through a DT process - recognizing how DT can help in functional work - How Agile and DT complement each other to deliver customer satisfaction.

TEXTBOOKS

There are no prescribed texts - there will be handouts and reference links shared.

REFERENCES

1. Nir Eyal. *Hooked: How to Build Habit-Forming Products*. New Delhi: Penguin, 2014.
2. Rod Judkins. *The Art of Creative Thinking*. New Delhi: Hachette Book Publishing, 2015
3. Dan Senor and Saul Singer. *Start-up Nation: The Story of Israel's Economic Miracle*, Grand Central Publishing, 2009
4. Simon Sinek, *Start with Why: How Great Leaders Inspire Everyone to Take Action*, Portfolio Penguin, 2011

WEB REFERENCES

- 1 What is Design Thinking? Interaction Design Foundation
- 2 What are some of the good examples of design thinking? - Quora
- 3 Design thinking 101: Principles, Tools & Examples to transform your creative process

ONLINE RESOURCES

- 1 Understanding Design thinking WF NEN
- 2 Design Thinking and Innovation at Apple Wei Li
- 3 Stanford Webinar- Design Thinking = Method, Not Magic
- 4 Stanford Design Thinking Virtual Crash Course
- 5 So Many Uses- activity to spark creativity and design

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• identify the steps in the DT process
Unit II	<ul style="list-style-type: none">• create/ develop personas and problem statements in the DT process
Unit III	<ul style="list-style-type: none">• examine the scope for doodling and storytelling in corresponding DT phases
Unit IV	<ul style="list-style-type: none">• estimate the significance of service value propositions and prototypes.

COURSE LEARNING OUTCOMES

Upon successful completion the course, the learner will be able to

- identify the steps in the DT process
- create/ develop personas and problem statements in the DT process
- examine the scope for doodling and storytelling in corresponding DT phases
- estimate the significance of service value propositions and prototypes

L	T	P	C
0	0	2	1

Course Code: CSE317

Semester: V

SOFTWARE DESIGN WITH UML LABORATORY

Course Objectives:

This course will help the learner to explore and model the software using UML that transforms the analysis data to design components which will be used for constructing the software.

LIST OF EXPERIMENTS

1. Choose a problem statement, analyze the problem and identify the requirements. Generate SRS document with the requirements. Design the software model and present it as the following models:
Case Modeling
2. Draw Use-case diagrams that depicts the relationship between the actors and the system
Interaction diagram
3. Depict the interactions between the objects using sequence diagram.
4. Emphasize the structural aspects of the objects (i.e., how the objects of the system are connected to each other) using Collaboration diagram
Static structure diagram
5. Identify the analysis classes and depict the relationship between these classes (Class diagram). The class diagram should project the relationships like Association, Generalization, Aggregation, Dependency, Interfacing, and Multiplicity
6. Simplify the complex class diagrams, group the classes as packages and draw package diagram.
Dynamic modeling
7. Draw state diagram that represent the system as number of states and interactions between states.
8. Represent the workflow of the systems using activities and actions using activity diagram.
9. Draw component diagram to represent both the physical and logical aspects of the system (connections and dependencies)
10. Construct deployment diagram that shows the execution architecture of a system, including nodes such as hardware or software execution environments, and the middleware connecting them.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

- Prepare the software requirement specification by thorough analysis of requirements
- Model the interaction between the use-cases as sequence and collaboration diagrams
- Design state structure diagrams using classes and packages
- Develop a dynamic model comprises of activity diagrams and state transition diagrams
- Design component and deployment models that represents the system components' interaction and execution architecture respectively

L	T	P	C
0	0	2	1

Course Code: CSE321**Semester: V****COMPILER DESIGN LAB****Course Objectives**

The learners will be able to design and implement the following phases of compiler like scanning and parsing, ad-hoc syntax directed translation, code generation, and code optimization for any formal language using Lex and YACC tools.

1. Develop a scanner using LEX for recognizing the token types in a given C program
2. Develop a program to find the FIRST and FOLLOW sets for a given Context Free Grammar
3. Extend the outcome of Experiment 2 to implement a LL(1) parser in C or Java to decide whether the input string is valid or not
4. Implement a LR(1) bottom up parser in C or Java to decide whether the input string is valid or not (Context- Free Grammar, Action and GOTO tables are supplied as inputs)
5. Develop a parser for all branching statements of 'C' programming language using LEX & YACC
6. Develop a parser for all looping statements of 'C' programming language using LEX & YACC
7. Develop a parser for complex statements in 'C' programming language with procedure calls and array references using LEX & YACC
8. Use LEX and YACC to create two translators that would translate a given input (compound expression used in experiment 9) into three-address and postfix intermediate codes. The input and output of the translators should be file
9. Write an optimizer pass in C or Java that does common-sub expression elimination on the three-address intermediate code generated in the previous exercise
10. Implement Local List Scheduling Algorithm
11. Implement Register Allocation
12. Use Lex & YACC to write a back end that traverses the three address intermediate code and generates x86 code

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Develop Scanners using Lex
- Develop Parsers with and without using Lex and Yacc
- Generate Intermediate codes for High level Language compound expressions.
- Make use of optimization techniques and generate machine level code.
- Implement a source to source translator
- Implement local list scheduling

L	T	P	C
3	1	0	4

Course Code: INTXXX

Semester: V

CONVERSATIONAL SYSTEMS

Course Objectives

This course will help the learner to enable attendees to acquire knowledge on chat boxes and its terminologies, as well as working with Machine Learning concepts and different algorithms to build custom ML Model

UNIT - I

15 Periods

Fundamentals of Conversational Systems: Overview - Case studies - Explanation about different modes of engagement for a human being - History and impact of AI. **Underlying technologies:** Natural Language Processing - Artificial Intelligence and Machine Learning - NLG - Speech-To-Text - Text-To-Speech - Computer Vision. **Introduction to Top players in Market:** Google - MS - Amazon & Market trends. **Messaging Platforms (Facebook, WhatsApp) and Smart speakers:** Alexa - Google Home and other new channels. **Ethical and Legal Considerations in AI Overview. Foundational Blocks for Programming:** Basic Python programming concepts - Node Basics - Coding Best Practices - Evaluation Test.

UNIT - II

15 Periods

Introduction: Brief history - Basic Concepts - Phases of NLP - Application of chatbotsetc - **General chatbot architecture, Basic concepts in chatbots:** Intents - Entities - Utterances - Variables and Slots - Fulfillment - Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc) - Lexical Analysis - Part-of Speech Tagging - Parsing/Syntactic analysis - Semantic Analysis - Word Sense Disambiguation - Information Extraction - Sentiment Analysis. **NLP using Python:** Make use of any of the NLP libraries like NLTK, spaCy, StanfordNLP etc - Affective NLG. **Building a chatbot/Conversational AI Systems:** Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture - Conversational Flow & Design - Intent Classification (ML and DL based techniques) - Dialogue Management Strategies - Natural Language Generation - UX design - APIs and SDKs - Usage of Conversational Design Tools.

UNIT - III

15 Periods

Introduction to popular chatbot frameworks: Google Dialog flow - Microsoft Bot Framework - Amazon Lex. **RASA Channels:** Facebook Messenger - Google Home - Alexa - WhatsApp - Custom Apps - Overview of CE Testing techniques - A/B Testing - Introduction to Testing Frameworks - Botium /Mocha Chai - Security & Compliance - Data Management - Storage - GDPR - PCI - Building a Voice/Chat Bot. **Role of ML/AI in Conversational Technologies:** Brief Understanding on how Conversational Systems uses ML technologies in ASR, NLP - Advanced Dialog management - Language Translation - Emotion/Sentiment Analysis - Information extraction ,etc. to effectively converse.

UNIT - IV

15 Periods

Contact Centers: Introduction to Contact centers - Impact & Terminologies - Case studies & Trends How does a Virtual Agent/Assistant fit in here?. **Overview on Conversational Analytics: Conversation Analytics :** The need of it - Introduction to Conversational Metrics. **Future - Where are we headed?:** Summary - Robots and Sensory Applications overview - XR Technologies in Conversational Systems - XR-Commerce - What to expect next? - Future technologies and market innovations overview.

TEXT BOOKS

1. Manning, C., & Schutze, H., *Foundations of Statistical Natural Language Processing*, MIT press, 1999
2. Bird, S., Klein, E., & Loper, E., *Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit*, O'Reilly Media, Inc., 2009
3. McTear, M., *Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots. Synthesis Lectures on Human Language Technologies*, 13(3), 1-251, 2020.

REFERENCES

1. Nitin Indurkha, Fred J. Damerau. *Hand Book of Natural Language Processing*, Chapman and Hall/CRC, Second Edition, 2010.
2. Mirjana Stankovic, Ravi Gupta, Bertrand A. Rossert, Gordon I. Myers, and Marco Nicol, *Exploring Legal, Ethical and Policy Implications of Artificial Intelligence*, 2017

ONLINE RESOURCES

1. <https://library.educause.edu/topics/emerging-technologies/extended-reality-xr>
2. <https://medium.com/syncedreview/conversational-systems-a-general-review-d47c9f33d5dd>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Understand the fundamentals of Conversational Systems • Discuss the different technologies such as Natural Language Processing, Artificial Intelligence and Machine Learning • Demonstrate the foundational blocks for python Programming
Unit II	<ul style="list-style-type: none"> • Illustrate the concept of chatbots in Conversational Systems • Design a chatbot/Conversational AI Systems using NLTK
Unit III	<ul style="list-style-type: none"> • Discuss the different RASA Channels such as Facebook Messenger - Google Home - Alexa - WhatsApp - Custom Apps • Employ the role of ML/AI in Conversational Technologies
Unit IV	<ul style="list-style-type: none"> • Understand the fundamentals of Contact Centers • Apply the XR Technologies in Conversational Systems

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Apply Natural Language processing, Machine Learning and Artificial Intelligence in the domain of Conversational Systems
- Understand the top players (Google - MS Amazon & Market trends) in Conversational Systems
- Demonstrate the NLP task using Python Programming with the use NLP libraries like NLTK, spaCy, StanfordNLP, etc. and construct the chatbot/Conversational AI Systems
- Identify the popular chatbot frameworks such as Google Dialog flow - Microsoft Bot Framework - Amazon Lex
- Demonstrate the sentiment analysis using Information Extraction Technology
- Identify the use of XR Technologies in Conversational Systems

L	T	P	C
3	1	0	4

Course Code: INT316

Semester: V

MODERN WEB APPLICATIONS

Course Objective:

This course will help the learner to be familiar with client server architecture and to develop a web based application by selecting appropriate technologies for client and server side programming along with database connectivity.

UNIT - I

15 Periods

Introduction to Internet and World Wide Web: History of the Internet - World Wide Web - Web Browsers - Web Servers - Uniform Resource Locator - Tools and Web Programming Languages - Web Standards - Categories of Web Applications - Characteristics of Web Applications - Tiered Architecture. **Hypertext Markup Language (HTML):** Basic HTML page - Text Formatting - Table - Headers - Linking - Images - List - Meta Elements. **Cascading Style Sheets (CSS):** Inline, Internal and External Style Sheet - Bootstrap CSS Text - CSS forms - CSS components drop down

UNIT - II

15 Periods

Java Script: Introduction to Java Scripts - Objects in Java Script - Dynamic HTML with Java Script - Bootstrap JS Alert - JS Button - JS popover. **Extensible Markup Language(XML):** Introduction - Structuring Data - Document Type Definition - XML Vocabularies - Document Object Model (DOM) with JavaScript - Extensible Stylesheet Language Transforms (XSL)

UNIT - III

15 Periods

Writing Basic PHP Programs: Creating PHP Programs - Numbers and Strings - Literals and Variables - Operators and Functions. **Form and PHP:** Creating Form Controls - Using Values Returned From - Forms Using PHP

UNIT - IV

15 Periods

PHP Database Connectivity: Connecting to MySQL Server - Selecting Databases - Checking for Errors - Closing the MySQL Server Connection. **Manipulating Data in MySQL Using PHP:** Inserting, Viewing, Updating and Deleting Records - Manipulating Joined Tables. **User Authentication:** Creating Session - Authorization Level

TEXTBOOKS

1. Deitel P. J., Deitel H. M. and Deitel A. *Internet and World Wide Web: How to Program*, Pearson Prentice Hall, 5th Edition, 2012.
2. Jon Duckett. *HTML and CSS: Design and Build Websites*, John Wiley & Sons Inc., 2011.
3. Naramore E., Gerner J. and Scouarnec Y. L. *Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer*, John Wiley & Sons Inc., 2005.

REFERENCES

1. Sebesta R. W. *Programming the World Wide Web*, Pearson Education, Eighth Edition, 2014.
2. Pressman R. and Lowe D. *Web Engineering: A Practitioner Approach*, Mc Graw Hill, First Edition, 2008.

3. Kappel G. *Web Engineering: The Discipline of systematic Development of Web Applications*, John Wiley & Sons Inc., First Edition 2006.
4. Suh W. *Web Engineering: Principles and Techniques*, Idea Group Inc., 2005.
5. Ullman L. *PHP for the Web: Visual Quick Start Guide*, Peachpit Press, Fifth Edition, 2016.

ONLINE MATERIALS

1. <https://nptel.ac.in/courses/106/105/106105084/>
2. <https://nptel.ac.in/courses/106/106/106106156/>

UNITWISE LEARNING OUTCOMES:

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Understanding the Basics of Internet and World Wide Web• Create interactive web pages using HTML• Design attractive web pages using CSS
Unit II	<ul style="list-style-type: none">• Create dynamic web pages using JavaScript and HTML• Describe XML schemas and Create XML objects for web services
Unit III	<ul style="list-style-type: none">• Implementing basic PHP programs using basic programming constructs• Design a PHP form in a web page and processing it on server side
Unit IV	<ul style="list-style-type: none">• Create and Demonstrate PHP Database Connectivity• Illustrate the Data manipulation in MySQL using PHP• Assess the user authentication using sessions

COURSE LEARNING OUTCOMES:

Upon successful completion of this course, the learner will be able to

- Understand the internet and client server architecture.
- Develop Interactive webpages by the use of HTML and CSS.
- Design dynamic web pages by integrating DHTML with JavaScript.
- Implement programs in PHP to demonstrate basics of PHP.
- Apply PHP Form controls and manipulate the forms in web sites.
- Analyse to use appropriate client-side or Server-side applications.
- Demonstrate the connection between a PHP program to a MySQL Database and perform insert, update and delete operations on the table.

L	T	P	C
3	1	0	4

Course Code: CSE428**Semester: V****CLOUD, MICRO SERVICES & APPLICATION****Course Objectives**

This course will help the learner to understand the fundamentals of developing application on Cloud, specifically public clouds such as AWS, AZURE and Google. It also helps the learner to design and deploy applications using cloud native services

UNIT - I**15 Periods**

Cloud Fundamentals- Cloud Components - Infrastructure - Application of Cloud Computing. **Cloud advantages** - Benefits - Limitations. **Cloud Deployment Models**-IaaS -PaaS - SaaS. Security Concerns-Regulatory issues. **Public Cloud Platforms overview and their Usage**-Google-AWS-Microsoft

UNIT - II**15 Periods**

Application Architectures-Distributed Computing Architecture landscape - System Architecture - Network Architecture - Software Architecture - Application Architecture-Scalable Architecture. **Introducing Microservice** - Modular Monolith - Independent Modules - Inter module communication - Microservices. **Spring Boot** - Performing data operation using spring boot and MongoDB - Creating a Spring Boot project - fundamentals and Design of Microservices. **API** - API Fundamental - API Management- API tools -Applications of API. **Introducing Cloud Native Architecture and Microservices** - Cloud Native Concepts - Understanding the twelve-Factors App.

UNIT - III**15 Periods**

Introduction to DevOps - Software delivery challenges - Microservice trend - Automation and tools. **DevOps with Containers** - Understanding containers - Life cycle of a container - working with a Docker file - Dockerizing your services

UNIT - IV**15 Periods**

Building Microservices in Python - Python concepts - Modelling Microservices - Building Microservices - Testing the RESTful API- Building a Web Application in Python - **Cloud security and Monitoring** - Monitoring the cloud Applications - **Use- cases** - AWS features (ex. Lambda Functions) -Microsoft Azure features- Google Cloud Platform Features

TEXTBOOKS

1. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw Hill, 2010.(Unit I)
2. Binildas Christudas , "Practical Micro services Architectural Patterns", Apress Publication, First Edition, 2019.(Unit - II)
3. Hideto Saito Hui-Chuan Chloe Lee Cheng-Yang Wum, DevOps with Kubernetes: Accelerating software delivery with container orchestrators, Packt Publishing, Second Edition, 2019.(Unit III)
4. Manish Sethi, "Cloud Native Python", Packt Publishing, 2017 (Unit-II, IV)

REFERENCES

- 1 Sam Newman, "Building Microservices Designing Fine-Grained Systems", O'Reilly Media publisher, 2015
- 2 M.S.V Janakiram, "Dimystifying the cloud - An Introduction to Cloud Computing", Version 1.1, 2010

ONLINE MATERIALS

1. <http://nptel.ac.in/courses/106106129/28>
2. <http://nptel.ac.in/courses/106106129/21>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Understand the Fundamentals, NIST definition and advantages of cloud• Discuss about the deployment models such as IaaS, PaaS, SaaS.• Describe the public cloud platform features such as AWS, Azure, Google.
Unit II	<ul style="list-style-type: none">• Explain the Microservices and API fundamentals• Classify the current and target system architecture design approach• Design micro services using spring boot• Illustrate the concept of cloud native architecture
Unit III	<ul style="list-style-type: none">• Demonstrate the DevOps Tools and their usage in cloud application development• Employ Docker and Containerization Process applications.
Unit IV	<ul style="list-style-type: none">• Employ the Python overview and use cases for cloud application• Discuss the cloud security and monitoring tools.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Understand the different components, benefits and limitations of cloud environment.
- Discuss about the various public cloud applications and its usages.
- Illustrate the microservices architecture design and deployment.
- Develop cloud applications using DevOps tools.
- Demonstrate the python overview and develop use cases for cloud environment.

L	T	P	C
3	0	0	3

Course Code: CSE322**Semester: VI****COMPUTER NETWORKING PRINCIPLES & COMPONENTS****Course Objective:**

This course will help the learner to identify types of network topologies & protocols and to gain expertise in specific areas of networking such as design and maintenance of individual networks

UNIT - I**12 Periods**

Introduction: Uses of computer networks - Transmission Modes: Serial and Parallel - Synchronous, Asynchronous and Isochronous - Simplex, Half duplex and full duplex - **Data communication Components:** Representation of data and its flow, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media - **LAN:** Wired LAN, Wireless LAN, Virtual LAN - **Techniques for Bandwidth utilization:** Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT - II**11 Periods**

Data Link Layer: Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go-back-N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA

UNIT - III**11 Periods**

Network Layer: Switching, Logical addressing - IPV4, IPV6; Address mapping - ARP, RARP, BOOTP and DHCP-Delivery, Forwarding and Unicast Routing protocols - **Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms

UNIT - IV**11 Periods**

Application Layer: DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls - **Network Security:** Electronic mail, directory services and network management, Basic concepts of Cryptography.

TEXT BOOKS

1. Andrew S Tanenbaum, David J. Wetherall, *Computer Networks*, Pearson Education, Fifth Edition, 2010.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, *Network Security: Private Communication in a Public World*, Prentice Hall Series in Computer Networking and Distributed Systems, 2002.

REFERENCES

1. Larry L Peterson, Bruce S. Davie, *Computer Networks: A Systematic Approach*, Elsevier, Fifth Edition, 2011.
2. William Stallings, *Data and Computer Communications*, Pearson Education, Tenth Edition, 2014.

ONLINE MATERIALS

1. http://nptel.ac.in/courses/IIT-MADRAS/Computer_Networks/index.php
2. http://nptel.ac.in/courses/Webcourse - contents/IIT%20Kharagpur/Computer%20networks/New_index1.html
3. <http://nptel.ac.in/courses/106105081/>

LEARNING OUTCOMES

The learner will be able to

Unit I	<ul style="list-style-type: none">• Discuss about the networking principles and its Quality of Service parameters• Demonstrate the physical layer functionalities
Unit II	<ul style="list-style-type: none">• Describe link layer functionalities and classify various multiple link access protocols• Demonstrate the appropriate MAC layer protocol for a given medium
Unit III	<ul style="list-style-type: none">• Discuss the issues in designing network layer protocols with QoS support.• Assemble Internet- Transport layer services and its significance in networking
Unit IV	<ul style="list-style-type: none">• Demonstrate the application layer functionalities• Discuss about the basic network security concepts

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Analyse the networking principles and various network QoS metrics
- Demonstrate link layer functionalities and multiple link access methods
- Compare various routing protocols in the network layer and evaluate Internet packet formatting and forwarding
- Criticise Transport layer services in Internet and evaluate TCP congestion and flow control mechanisms
- Discuss about various application layer protocols
- Discuss about the basic network security concepts

L	T	P	C
3	1	0	4

Course Code: INT313

Semester: VI

COMPUTER SYSTEM SECURITY

Course Objectives

This course will help the learner to understand the key features of computer systems security and discuss the Security Design, Security Policies with Network and database security.

UNIT - I

15 Periods

Overview of Security Parameters: Confidentiality - integrity and availability - Security violation and threats - Security policy and procedure - Assumptions and Trust - Security Assurance - Implementation and Operational Issues - Security Life Cycle. **Access Control Models:** Discretionary - mandatory - roll-based and task-based models - unified models - access control algebra - temporal and spatio-temporal models.

UNIT - II

15 Periods

Security Policies: Types - Role of trust and access control - Examples. **Confidentiality policies-** The Bell-LaPadula Model, Examples. **integrity policies** - Biba Integrity Model - Low-Water-Mark and Ring Policy Models- Lipner's Integrity Matrix , Lipner's Use of the Bell-LaPadula, Lipner's Full and Clark-Wilson Integrity models. **hybrid policies** - Chinese Wall Model, Formal Model, Bell-LaPadula and Chinese Wall - Clark-Wilson and Chinese Wall model. **Non-Interference And Policy Composition** - Deterministic Noninterference - Unwinding Theorem - international standards.

UNIT - III

15 Periods

Systems Design: Design principles. **Representing Identity-** files and objects - Users - Groups and roles - Naming and certificate - identity on the web. **Control of Access and Information flow, confinement problem-** Isolation and covert channels - Composition of Deterministic Non-Interference-Secure Systems and Deducibly Secure Systems. **Assurance:** Building systems with assurance - formal methods - evaluating systems.

UNIT - IV

15 Periods

Logic-based System: Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, operating system security, user security, program security. Special Topics: Data privacy, introduction to digital forensics, enterprise security specification. **Operating Systems Security:** Security Architecture, Analysis of Security in Linux/Windows. **Database Security:** Security Architecture, Enterprise security, Database auditing.

TEXTBOOKS

1. Mark Stamp, *Information Security: Principles and Practice*, Wiley Publications, Second Edition, 2011
2. Ross Anderson, *Security Engineering A Guide to Building Dependable Distributed Systems*, Wiley Publications, Third Edition, 2020.
3. M. Bishop, *Computer Security: Art and Science*, Second Edition, Pearson Education, 2019.

REFERENCES

1. C.P. Pfleeger, S.L. Pfleeger, J. Margulies, *Security in Computing*, Pearson Education, Fifth Edition, 2015,
2. David Wheeler, *Secure Programming: HowTo*, 2015
3. Michael Zalewski, *Browser Security Handbook*, Google Inc., 2009
4. M. Gertz, S. Jajodia, *Handbook of Database Security, Application and Trends*, Springer, 2008.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Understand the basics of computer system security• Aware of various access control models.
Unit II	<ul style="list-style-type: none">• Identify different kinds of security policies• Know the security policy models , international standards.
Unit III	<ul style="list-style-type: none">• Comprehend system design identity• Grasp control access , confinement problem and Assurance
Unit IV	<ul style="list-style-type: none">• Become aware of vulnerability with intrusion detection• Gain knowledge about operating system and database security.

COURSE LEARNING OUTCOMES

Upon successful completion of the course, the learner will be able to

- Explain the needs of computer and Information security.
- Understand the various Information security policies.
- analyse the various security policy models for designing security techniques.
- Understand the basics of security design principles with various models for information security
- Gain knowledge to analyse the security issues in database and operating system
- Defend the importance of enforcing security in information communication

L	T	P	C
3	0	0	3

Course Code: INT314

Semester: VI

ARTIFICIAL INTELLIGENCE & LOGICAL REASONING

Course Objectives

This course helps the learner to understand the basic knowledge representation, problem solving and logical reasoning. It also helps the learner to understand various methods of solving problems using artificial intelligence.

UNIT - I

11 Periods

Introduction: Problems of AI - AI technique - Tic-Tac-Toe problem - Intelligent Agents: Agents & environment - nature of environment - structure of agents - goal based agents - utility based agents - learning agents. **Problem Solving, Problems, Problem Space & search:** Defining the problem as state space search - production system - problem characteristics - issues in the design of search programs. **Search techniques:** Problem solving agents - searching for solutions - uniform search strategies- breadth first search - depth first search - depth limited search - iterative deepening - bidirectional search - comparing uniform search strategies.

UNIT - II

11 Periods

Heuristic search strategies: Greedy best-first search - A* search - AO* search - memory bounded heuristic search. local search algorithms & optimization problems: Hill climbing search - simulated annealing search - local beam search. **Constraint satisfaction problems:** Local search for constraint satisfaction problems. **Adversarial search:** Games, optimal decisions & strategies in games - the minimax search procedure - alpha-beta pruning

UNIT - III

11 Periods

Knowledge & reasoning: Knowledge representation issues - representation & mapping - approaches to knowledge representation. Inferences in predicate logic - representing simple fact in logic: propositional Vs Predicate inference - resolution - natural deduction - representing instant & ISA relationship - computable functions & predicates -. Representing knowledge using rules - Procedural verses declarative knowledge - logic programming - forward verses backward reasoning - matching - control knowledge.

UNIT - IV

12 Periods

Probabilistic reasoning: Representing knowledge in an uncertain domain - the semantics of Bayesian networks - Dempster-Shafer theory - Planning Overview - components of a planning system - Goal stack planning - Hierarchical planning - other planning techniques. **Expert Systems:** Representing and using domain knowledge - expert system shells - and knowledge acquisition.

TEXTBOOKS

1. Stuart Russell and Peter Norvig. *Artificial Intelligence - A Modern Approach*. Pearson Education / Prentice Hall of India, Third Edition, 2014.
2. Elaine Rich and Kevin Knight. *Artificial Intelligence*, Tata McGraw-Hill, New Delhi, Third Edition, 2008.

REFERENCES

1. Dan.W.Patterson, *Introduction to Artificial Intelligence & Expert Systems*, Pearson Education India, First Edition, 2015.
2. Saroj Kaushik, *Logic & Prolog Programming*, New Age International, First Edition, 2002.
3. Joseph Giarratano and Gary Riley, *Expert Systems*, PWS Publishing, Boston, Third Edition, 1998.

ONLINE MATERIALS

1. NPTEL- <https://nptel.ac.in/courses/106105077/>
2. MIT Courseware - <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Classify categories of agents based on their relationship with the environment• Solve problems involving uninformed environment during searching solutions
Unit II	<ul style="list-style-type: none">• Choose an appropriate informed searching technique for the given problem• Determine the optimal search technique for the given constraint to solve the problem
Unit III	<ul style="list-style-type: none">• Represent and use knowledge and logic in various ontological problems• Judge, which representation is suitable under which circumstance
Unit IV	<ul style="list-style-type: none">• Understand the ways and means to probabilistic reasoning• Explain the nature and application areas of expert system tools

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Classify intelligent agents based on their relationship with the environment
- Choose an appropriate search strategy for problem solving
- Choose appropriate ontology and logic for knowledge representation and inference
- Discuss the various expert systems attributes and tool of real world problems

L	T	P	C
3	1	0	4

Course Code: MGTXXX**Semester: VI****FINANCIAL & COST ACCOUNTING****Course Objectives**

The course is aimed to familiarize the learners about the fundamentals of accounting, and to impart knowledge on analysis of financial statements and cost concepts and its importance, applications and to help learners to understand about the cost concepts and methods of costing, budgeting and about annual reports and its statutory requirements.

UNIT - I**15 Periods**

Fundamentals of financial Accounting: Role of accounting in business; Generally Accepted Accounting Principles - Concepts and Conventions; Business transactions and accounting equation - capital and revenue expenditure; Accounting cycle: Journal, ledger and Trial balance, Preparation of financial statements: Income statement and Balance Sheet- Bank Reconciliation Statement- Rectification of errors - Depreciation Accounting Interpreting the financial statements: Comparative and Common size Income statements, Balance Sheet- Trend analysis - Preparation and Interpretation of Fund Flow & Cash flow Statement - Ratio Analysis.

UNIT - II**15 Periods**

Fundamentals of cost and Management Accounting: Comparing management accounting with financial accounting and cost accounting - Role of Cost and Management Accountant- Basic Cost Concepts: Cost Unit - Cost Centre - Classification of Costs - Cost Sheet: Steps in preparation of Cost Sheet - Tender quotation - Major components of cost: Material/Labour/Overheads- Job Costing- Batch costing - Process Costing (with normal and abnormal loss and gain) - Contract Costing - Operations Costing - Operating Costing - Activity Based Costing - Target Costing.

UNIT - III**15 Periods**

Budgetary Control and Marginal Costing: Budgeting as a Tool of Management Planning and Control - Functional Budgets - Master Budget - Performance Budgeting - Zero Base Budgeting- Standard Costing: Standard Cost - Objectives - Need - Application - Advantages - Limitations of Standard Costing; Marginal Costing and Managerial Decision Making- Cost-Volume-Profit Analysis - Applications of CVP Analysis

UNIT - IV**15 Periods**

Annual Reports and Statutory Requirements: Integrated Reporting - Disclosure requirements - Audit of Companies- Environmental Audit- Audit under computerized environment - Accounting packages and ERP - International Financial Reporting Standards (IFRS) - Introduction - need - similarities of Indian GAAP, Ind AS and IFRS; XBRL - Introduction - Advantages of XBRL Reporting

REFERENCES

1. Dr. Ashok Sehgal and Dr. Deepak Sehgal, *Accounting for Management*, Taxmann Publications (P) Ltd., 2012
2. T. P. Ghosh, *Financial Accounting for Managers*, Taxmann Publications (P) Ltd., Fourth Edition, 2012.
3. Paresh Shah, *Basic Financial Accounting for Management*, Oxford University Press, 2012.
4. R. Narayanaswamy, *Financial Accounting - A Managerial Perspective*, PHI Learning Private Limited, 2012
5. Subhash Sharma & Vithal M.P., *Financial accounting for Management - Text and Cases*,

- Macmillan India Ltd., 2008.
6. S. K. Bhattacharya and John Dearden, *Accounting for Management - Text & Cases*, Vikas Publishing House Pvt. Ltd., 2012.
 7. *Companies Act - Schedule VI*

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• prepare of Income Statement and balance sheet and analyse the performance of a company and to comment on the financial position of the business
Unit II	<ul style="list-style-type: none">• understand the scope and objectives of cost and management accounting• prepare cost sheet and familiar with costing methods
Unit III	<ul style="list-style-type: none">• prepare the functional budgets and apply the standard costing technique for cost control• apply various managerial decision-making techniques by using CVP analysis
Unit IV	<ul style="list-style-type: none">• understand the recent developments in the field of auditing, ERP, XBRL reporting and accounting standards

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- prepare of Income Statement and balance sheet and analyse the performance of a company and to comment on the financial position of the business
- understand the scope and objectives of cost and management accounting
- prepare cost sheet and familiar with costing methods
- prepare the functional budgets and apply the standard costing technique for cost control
- apply various managerial decision-making techniques by using CVP analysis
- understand the recent developments in the field of auditing, ERP, XBRL reporting and accounting standards

L	T	P	C
2	1	0	3

Course Code: ENG316**Semester: VI****BUSINESS COMMUNICATION & VALUE SCIENCE - IV****Course Objectives:**

This course helps the learner to recognize the best practices of communicative writing, use the best practices of public speaking in real life scenarios, apply emotional intelligence in personal and professional lives, use best practices to manage stress that impacts life and work, and identify the importance of corporate social responsibility (CSR)

UNIT - I**15 Periods**

Communicative Writing: Principles of Communicative Writing - Formal and Business letters - Format & Style; Writing proposals - best practices and templates for writing proposals - writing a funding proposal to begin a start-up - charts and graphs in communicative writing - visual representation of information to tell the complete story of beginning the start-up - Business idioms and corporate terms - concept of public speaking - best practices of public speaking - Apply public speaking in real life scenarios - Get, Set, Go - sell your startup ideas (Name of start-up, Who is the target audience/end user? What problem will start-up solve? How to plan to run start up? How much money/budget is needed to begin work?)

UNIT - II**10 Periods**

Emotional intelligence: Importance of emotional intelligence in personal and professional lives - importance of EQ in building more productive relationships - Applying emotional intelligence in real life scenarios -Key features of Corporate etiquette.

UNIT - III**12 Periods**

Understanding conflicts: Causes and impacts (positive & negative) of conflicts at work place - Basic solutions and guidelines to manage conflicts - causes and impacts of stress - solutions and guidelines to manage stress - concept of locus of control - identify internal and external locus of control - impact of locus of control on individual's behaviour and performance - Role Play to manage conflicts at work with empathy and active listening. Importance of giving and receiving feedback - guidelines to give and receive feedback - importance of time-management for better lifestyle - challenges in time-management

UNIT - IV**8 Periods**

Diversity in workplace: Introduction to the concept of Diversity in corporate environments - Corporate social responsibility (CSR) - Stalwarts in CSR and Tata Group CSR - importance of CSR in connecting to personal values and resumes.

TEXTBOOK

There are no prescribed texts- there will be handouts and reference links shared.

REFERENCES

1. Goleman, Daniel. 2005. *Emotional Intelligence: Why it Can Matter More Than IQ*. New York: Bantam Press
2. David, Ryback. 1998. *Putting Emotional Intelligence to Work*. London: Routledge.

3. Carnegie, Dale. How to Develop Self Confidence and Improve Public Speaking - Time-tested Methods of Persuasion. New Delhi: General Press.
4. Anderson, Chris. 2016. TED Talks: The official TED guide to public speaking: Tips and tricks for giving unforgettable speeches and presentations. London: Nicholas Brealey Publishing

WEB REFERENCES

1. <https://www.tata.com/about-us/tata-group-our-heritage>
2. <https://economictimes.indiatimes.com/tata-success-story-is-based-on-humanity-philanthropy-and-ethics/articleshow/41766592.cms>

ONLINE RESOURCES

1. <https://youtu.be/reu8rzD6ZAE>
2. https://youtu.be/Wx9v_J34Fyo
3. <https://youtu.be/F2hc2FLOdhl>
4. <https://youtu.be/wHGqp8lz36c>
5. <https://youtu.be/hxS5He3KVEM>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	• Recognise the best practices of communicative writing
Unit II	• Apply emotional intelligence in real life scenarios
Unit III	• Demonstrate best practices to manage stress in both personal life and work
Unit IV	• Discover the importance of Corporate Social Responsibility (CSR)

COURSE LEARNING OUTCOMES

- Recognise the best practices of communicative writing
- Apply emotional intelligence in real life scenarios
- Demonstrate best practices to manage stress in both personal life and work
- Discover the importance of Corporate Social Responsibility (CSR)

L	T	P	C
0	0	2	1

Course Code: CSE323R01**Semester: VI****COMPUTER NETWORKING PRINCIPLES & COMPONENTS LABORATORY****Course Objectives**

This course will help the learner to understand the network simulator environment. Also the learner will be able to understand working principle of various communication protocols and visualize the network protocol performance metrics.

List of experiments

1. Simulation and analysis of Wired Network in NS2/NS3
2. Simulation and analysis of Wireless Network in NS2/NS3
3. Implementation of error-detection technique - CRC
4. Implementation of error-correction technique - Hamming code
5. Implementation and analysis of Sliding window protocols
6. Implementation of Dynamic Host Configuration Protocol
7. Implementation and analysis of Distance vector routing
8. Implementation and analysis of Link State Routing
9. Implementation and analysis of Leaky bucket and Token bucket congestion control algorithms
10. Implementation of DNS lookup
11. Implementation of secured file transfer
12. Study of SASTRA network infrastructure

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcomes	Knowledge Level
1	Demonstrate wired and wireless network simulation	K3
2	Differentiate error detection and error correction techniques	K4
3	Analyse the performance of flow control techniques	K4
4	Compare various adaptive routing protocols	K4
5	Demonstrate various congestion controls algorithms	K4
6	Analysis of application layers services	K4

L	T	P	C
0	0	2	1

Course Code: INT315

Semester: VI

ARTIFICIAL INTELLIGENCE & LOGICAL REASONING LABORATORY

Course Objectives

This course helps the learner to gain practical knowledge in various problem solving approaches for artificially intelligent systems. It also helps the learner to practice knowledge representation and retrieval techniques.

Prerequisite: Basic knowledge in R/ Python/ MATLAB programming as the exercises are to be carried out in these languages

1. Solve path planning problem using Breadth First Search
2. Apply Depth First Search for searching attribute subset space
3. Use Iterative Deepening Depth limited search to solve 8-puzzle problem
4. Implement greedy search for searching attribute subset space
5. Implement A* algorithm for shortest path problem
6. Implement Genetic Algorithm for solving 8-queens' problem
7. Implement Alpha-Beta Pruning for solving Tic-Tac-Toe game
8. Solve crypt arithmetic problem using ALLDIFF Constraints
9. Write simple programs for creating terms variables and atoms
10. Write simple FOL statements for Knowledge Representation

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Choose an appropriate Informed and uninformed search strategy for problem solving
- Demonstrate Local Search Algorithms for solving real world problems
- Implement Adversarial Search algorithms for games
- Choose appropriate ontology and logic for knowledge representation and inference

L	T	P	C
3	1	0	4

Course Code: CSEXXX

Semester: VI

ROBOTICS AND EMBEDDED SYSTEMS

Course Objectives

This course will help the learner to develop interface for robotic system with the help of stepper motor and sensors by understanding the fundamentals embedded system design using micro controller and microprocessor and kinematics of robot motion.

UNIT - I

15 Periods

Introduction to Embedded System: Embedded system Vs General computing systems - History of Embedded systems - Purpose of Embedded systems - Microprocessor and Microcontroller - Hardware architecture of the real time systems. **Communication Devices:** I/O types - serial and parallel communication devices - wireless communication devices - timer and counting devices - watchdog timer - real time clock

UNIT - II

15 Periods

Communication Buses: Serial bus communication protocols - parallel communication network using ISA, PCI, PCT-X - Internet embedded system network protocols - USB, Bluetooth. **Program Modeling Concepts:** Fundamental issues in Hardware software co-design - Unified Modeling Language (UML) - Hardware Software trade-offs DFG model - state machine programming model - model for multiprocessor system.

UNIT - III

15 Periods

Real Time Operating Systems: Operating system basics - Tasks, Process and Threads - Multiprocessing and multitasking - task communication - task synchronization - qualities of good RTOS. **Examples of Embedded System:** Mobile phones - RFID - WISENET - Robotics - Biomedical Applications - Brain machine interface etc. - Popular microcontrollers used in embedded systems - sensors - actuators.

UNIT - IV

15 Periods

Robotics: Introduction - Elements of robots - joints, links, actuators, and sensors. **Kinematics:** Kinematics of serial robots - Kinematics of parallel robots - Motion planning and control. **Advanced Topics on Robotics:** Sensing distance and direction - Line Following Algorithms - Feedback Systems - Other topics on advance robotic techniques

TEXT BOOKS

1. Shibu K. V., *Introduction to Embedded Systems*, Tata McGraw-Hill Education, First Edition, 2009.
2. F. Vahid *Embedded System Design - A unified Hardware and Software Introduction*, John Wiley, First Edition, 2002,.
3. Rajkamal, *Embedded Systems*, Tata McGraw-Hill Education, Second Edition, 2011.
4. L. B. Das, *Embedded Systems*, Pearson Education, First Edition, 2012.
5. Muhammad Ali Mazidi, *The 8051 Microcontroller and Embedded Systems*, Prentice Hall of India, First Edition, 2007.
6. Ashitava Ghosal, *Robotics: Fundamental Concepts and Analysis*, Oxford University Press, First Edition, 2006.

REFERENCES

1. S. Heath, "Embedded System design", Elsevier, Second Edition, 2002.
2. G. Osborn, "Embedded microcontroller and processor design", Pearson Education, 2010.
3. Steve Heath, "Embedded systems design", Newnes, Second Edition, 2002.

ONLINE MATERIALS:

1. <https://nptel.ac.in/courses/108/102/108102045/>
2. <http://nptel.ac.in/courses/112/101099>

LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Understand the embedded system fundamentals• Classify the I/O devices used in embedded system
Unit II	<ul style="list-style-type: none">• Distinguish between types of bus, protocols used for communication• Address the issues in designing and design using UML
Unit III	<ul style="list-style-type: none">• Identify the different aspects of multi tasking in RTOS with industrial applications
Unit IV	<ul style="list-style-type: none">• Explore the elements of autonomous robot system

COURSE OUTCOMES

Upon successful completion of the course, the learners will be able to

- Understand the microcontrollers embedded processors and their applications
- Understand the functioning of the different types of I/O and communication devices
- Differentiate the communication buses and protocols for communication
- Design a state programming model for multiprocessor system
- Distinguish between the multi thread, multi-processing, multi-tasking and industrial applications of RTOS
- Understand the elements of the Robot system and analyze the kinematics to design autonomous robots with sensors.

L	T	P	C
3	1	0	4

Course Code: CSE415R01

Semester: VI

INTERNET OF THINGS

Course Objective

This course will help the learner to describe the fundamental of IoT, to create small low-cost embedded systems to illustrate to IoT concepts in real world scenarios.

UNIT - I

15 Periods

Introduction to IoT: Definition and Characteristics of IoT - Physical Design of IoT: Things in IoT - IoT Protocols - Logical Design of IoT: Function blocks - Communication Models - Communication APIs - IoT Enabled Technologies - IoT Levels and Deployment Templates - **Domain Specific IoTs:** Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle. **Components in IoT:** Control Units - Sensors - Communication modules - Power Sources - Communication Technologies - RFID - Bluetooth - Zigbee - Wifi - Rfinks - Mobile Internet – Wired Communication.

UNIT - II

15 Periods

IoT and M2M: M2M - Difference between IoT and M2M - Software Defined Networks - Network Function virtualization - IoT System Management with NETCONF - YANG - Need for IoT systems management - SNMP - Network Operator requirements - IoT systems management. **Developing IoT:** IoT Design Methodology: Purpose & Requirements Specification - Process Specification - Domain Model Specification - Information Model Specification - Service Specifications - IoT Level Specifications - Functional View Specification - Operational View Specification - Device & Component Integration - Application Development - Case study on IoT for Weather Monitoring

UNIT - III

15 Periods

IoT Physical Devices and Endpoints: Motivation for using Python, Python Packages of Interest for IoT, Building blocks of an IoT Device, Exemplary device: Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces - Serial, SPI, I2C, Programming Raspberry Pi with Python - Other IoT Devices

Realization of IoT Ecosystem for Wireless technologies: Architecture of IoT using mobile devices - Mobile Technologies for supporting IoT Ecosystem - Energy Harvesting for Power Conservation in the IoT System - Mobile Application Development Platforms - Low Power Wide Area Technologies. **Infrastructure and service-oriented Discovery protocols for the IoT Ecosystem:** Layered architecture for IoT - Protocol Architecture of IoT - Infrastructure protocols - Protocols for IoT service Discovery

UNIT - IV

15 Periods

The Enablement Platform for IoT applications and Analytics: The IoT building Blocks - IoT Application Enablement Platforms - Characterizing IoT or M2M Application Platforms - IoT AEPs - Azure IoT Hub - Amazon Web service IoT Platform - the Axeda IoT Platform - IoT data Analytics Platforms - IoT Data Virtualization Platforms - IoT Data Visualization Platform – IoT Edge Data Analytics **The Next generation Clouds for IoT Applications and Analytics:** Motivation for Cloud Enabled Environments - IoT and cloud Inspired Smarter environments - Hybrid Clouds - Emergence of Edge/Fog Clouds - Building Blocks of Software Defined Networking - Software Defined Storage.

Expounding the Edge/Fog Computing paradigm: Introduction to Edge/Fog Computing - Fog Computing Concepts - Use Cases of Fog/Edge Computing - Edge Analytics

TEXT BOOKS

1. ArshdeepBahga, Vijay Madiseti, *Internet of Things: A Hands of Approach*, ArshdeepBahga & Vijay Madiseti, First Edition, 2014.
2. Pethuru Raj, Anupama C.Raman, *The Internet of Things: Enabling Technologies, Platforms, and use cases*, CRC Press, First Edition, 2017.
3. CharalamposDoukas, *Building Internet of Things with the Arduino*, Volume 1, Create Space Independent Publishing Platform, First Edition, 2012.

REFERENCES

1. HonbaZhou, *The Internet of things in the Cloud: A Middleware Perspective*, CRC Press, First Edition, 2012.
2. Adrian McEwen, Hakim Cassimally, *Designing the Internet things*, John Wiley and Sons, First Edition, 2014.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will able to

Unit I	<ul style="list-style-type: none"> Describe the physical design, logical design, IoT enabled technologies and their components Illustrate the applications in specific domains
Unit II	<ul style="list-style-type: none"> Differentiate IoT and M2M Describes a generic design methodology for IoT Platforms
Unit III	<ul style="list-style-type: none"> Design a cost effective, energy efficient and environment friendly IoT application using embedded boards Explain the wireless technologies and infrastructure protocols specific to IoT systems
Unit IV	<ul style="list-style-type: none"> Identify the various intelligent platforms Illustrate the role of Edge and Fog computing in IoT

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will able to

CO No.	Course Outcomes	Knowledge Level
1	Describe the physical and logical designs of IoT-enabled technologies	K2
2	Differentiate IoT and M2M	K4
3	Describes a generic design methodology for IoT Platforms	K2
4	Design a cost effective, energy efficient and environment friendly IoT application using embedded boards	K4
5	Explain the wireless technologies and infrastructure protocols specific to IoT systems	K2
6	Illustrate the role of Edge and Fog computing in IoT	K3

L	T	P	C
3	1	0	4

Course Code:

Semester: VI

BEHAVIORAL ECONOMICS

Course Objectives:

This course will help the learner to have an understanding on the current ideas and concepts regarding decision making in Economics, particularly from a behavioural science perspective that can affect the choices and behaviour of firms, households and other economic entities

UNIT – I

15 Periods

Introduction to behavioral economics: The neoclassical/standard model and behavioral economics in contrast - historical background - behavioral economics and other social sciences - theory and evidence in the social sciences and in behavioral economics - applications – gains and losses - money illusion - charitable donation.

UNIT - II

15 Periods

Basics of choice theory: Revisiting the neoclassical model - utility in economics and psychology - models of rationality - connections with evolutionary biology and cognitive neuroscience - policy analysis - consumption and addiction, environmental protection, retail therapy - applications - pricing, valuation.

UNIT – III

15 Periods

Beliefs, heuristics, biases and Strategic choice: Revisiting rationality - causal aspects of irrationality - different kinds of biases and beliefs - self-evaluation and self-projection - inconsistent and biased beliefs - probability estimation - trading applications – trade in counterfeit goods, financial trading behavior, trade in memorabilia-Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, competitive sports, bargaining and negotiation, monopoly and market entry.

UNIT - IV

15 Periods

Choice under uncertainty and intertemporal choice: Background and expected utility theory - prospect theory and other theories - reference points - loss aversion - marginal utility - decision and probability weighting - applications – ownership and trade, income and consumption, performance in sports. Geometric discounting - preferences over time - anomalies of inter-temporal decisions - instantaneous utility - alternative concepts.

TEXTBOOK

1. N. Wilkinson and M. Klaes, *An Introduction to Behavioural Economics*, Bloomsbury Publishing, Third Edition, 2017.

REFERENCES

1. David. R. Just, *Introduction to Behavioural Economics: Noneconomic Factors That Shape Economic Decisions*, Wiley publications, 2014
2. Edward Cartwright, *Behavioural Economics*, Routledge publications, 2018

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Understand the inter disciplinary concept of behavioral economics with other social sciences
Unit II	<ul style="list-style-type: none">• Analyze utility, value, pricing etc
Unit III	<ul style="list-style-type: none">• Understand the behaviour and its processes related to different kinds of biases and beliefs
Unit IV	<ul style="list-style-type: none">• Identify the decision-making process related to uncertainty.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Understand the main normative and descriptive approaches in understanding the principles of decision making under risk	K2
2	Apply the concepts related to economic and psychological approach to human decisions	K3
3	Analyze the main heuristics and biases in human decisions and interpret them.	K4
4	Analyze motives and evidence for social cooperation and problems of coordination of individual decisions	K4
5	Evaluate the Knowledge of motives and evidence for social cooperation and problems of coordination of individual decisions	K5
6	Create models of behavioural theory	K6

L	T	P	C
2	0	0	2

Course Code: CSE332

Semester: VII

USABILITY DESIGN OF SOFTWARE APPLICATIONS

Course Objectives:

This course will help the learner to enhance their innovation and creative thinking skills to venture usability design in building software applications

UNIT - I

8 Periods

Interaction Design: Good and Poor Design – Interaction Design – Process – Goals – Design and Usability Principles. **Understanding and Conceptualizing Interaction:** Problem Space – Conceptual Models – Interface Metaphors – Interaction Paradigms – Conceptual models to Physical Design.

UNIT - II

8 Periods

Understanding Users: Cognition – Knowledge from Physical to Digital World – Conceptual Frameworks for Cognition – Informing Design. **Designing for Collaboration and Communication:** Social Mechanisms – Ethnographic Studies – Conceptual Frameworks.

UNIT – III

7 Periods

Process of Interaction Design: Activities – Characteristics - Lifecycle Models. **Identifying needs and Establishing Requirements:** What, How and Why – Requirements – Data gathering – Data Interpretation and Analysis – Task Description – Task Analysis.

UNIT - IV

7 Periods

Design Prototyping and Construction: Prototyping and Construction – Conceptual Design – Physical Design – Tool Support. **User-centered approaches to interaction design:** Importance - user-centered approach - understanding user's work - involving users in design. **Evaluation Framework:** Paradigms and techniques - DECIDE evaluation framework.

TEXTBOOK

1. Rogers, Yvonne and Sharp, Helen. *Interaction Design: Beyond Human-Computer Interaction*. John Wiley & Sons, Fourth Edition, 2003.

REFERENCES

1. Cooper, Alan, Robert Reimann, David Cronin, and Christopher Noessel. *About face: the essentials of interaction design*. John Wiley & Sons, Fourth Edition, 2014.
2. Goodman, Elizabeth, and Mike Kuniavsky. *Observing the user experience: A practitioner's guide to user research*. Elsevier, Second Edition, 2012.
3. Schneider, Jonny. *Understanding design thinking, lean, and agile*. O'Reilly Media, Incorporated, First Edition, 2017.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">Understand and conceptualize user interface and interaction requirementsDistinguish conceptual interaction models to physical user interaction designs
Unit II	<ul style="list-style-type: none">Describe different cognition conceptual frameworks on interaction designIllustrate the collaboration and communication of users for eliciting usability requirements
Unit III	<ul style="list-style-type: none">Demonstrate the activities and processes involved in good interaction designCollect, interpret and analyze interaction design data and develop use cases
Unit IV	<ul style="list-style-type: none">Create interaction design prototypes from conceptual design to physical designEvaluate interaction design prototype using DECIDE framework

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course Outcome	Knowledge Level
1	Distinguish conceptual interaction models to physical user interaction design	K2
2	Describe different cognition conceptual frameworks on interaction design	K2
3	Illustrate the collaboration and communication of users for eliciting usability requirements	K3
4	Demonstrate the activities and processes involved in good interaction design	K3
5	Collect, interpret and analyze interaction design data and develop use cases	K4
6	Create interaction design prototypes from conceptual design to physical design	K6

L	T	P	C
3	0	0	3

Course Code:INT318

Semester: VII

IT WORKSHOP SCILAB / MATLAB

Course Objectives:

This course will help the learner to understand the MATLAB environment. This course also focuses on MATLAB programming, GUI, design programs in MATLAB to solve scientific, mathematical and real time problems.

UNIT - I

11 Periods

Introduction: History, basic features, strengths and weaknesses, good programming practices and plan your code. **Working with variables, workspace and miscellaneous commands:** Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands.

UNIT - II

11 Periods

Matrices and Arrays: Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix generators, special matrices, array and array operations, solving linear equations, other mathematical functions. **Basics plotting:** Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours.

UNIT – III

11 Periods

M-Files: Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands. **Control flow and operators:** "if ... end" structure, relational and logical operators, "for ... end" loop, "while ... end" loop, other flow structures, operator precedence, saving output to a file.

UNIT - IV

12 Periods

Debugging M-Files: Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file. **MATLAB GUI:** Creating ICE's graphical user interface, programming the ICE interface, initialization code, opening and output functions.

TEXTBOOKS

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, *Digital Image Processing using MATLAB*, Pearson Education, Inc., Second Edition, 2004.
2. Stormy Attaway *MATLAB: A Practical Introduction to Programming and Problem Solving*, Butterworth-Heinemann, Sixth Edition, 2023.

REFERENCES

1. Stephen J.Chapman, *Essentials of MATLAB Programming*, Cengage Learning, Third Edition, 2016.
2. Holly Moore, *MATLAB for Engineers*, Pearson Prentice Hall, Fifth Edition, 2018.

ONLINE MATERIALS

1. <https://www.mathworks.com/content/dam/mathworks/mathworks-dot com/moler/exm/book.pdf>
2. https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Understand the basic concepts of MATLAB programming• Understand the MATLAB commands and workspace
Unit II	<ul style="list-style-type: none">• Illustrate the computations on matrices and array• Visualize dataset using various plotting methods
Unit III	<ul style="list-style-type: none">• Select an appropriate construct to solve the given problem• Design programs using functions, branching and looping constructs
Unit IV	<ul style="list-style-type: none">• Debug M-files to correct errors• Create applications using MATLAB GUI

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course Outcome	Knowledge Level
1	Understand the basics of MATLAB programming and commands	K2
2	Apply plotting techniques to visualize the data set	K3
3	Analyze digital images and signals using matrices and array	K4
4	Create MATAB programs to solve the given problem	K5
5	Analyze M-Files to remove errors in a program	K3
6	Develop applications to solve real time problems using MATLAB GUI	K6

L	T	P	C
3	0	0	3

Course Code: MGT212

Semester: VII

INTRODUCTION TO FINANCIAL MANAGEMENT

Course Objectives:

To identify the necessity of basics of financial managerial applications for a modern business and different techniques of calculating the cost of the capitals in modern firms for the sake of stockholders and leveraging the concept for deciding financial angle of IT projects

UNIT – I

11 periods

Introduction to Financial Management: Overview of Financial Management: Scope - Functions and Objectives - Profit Vs Wealth maximisation - Finance Decisions - Roles and Responsibilities of Finance Manager. **Time Value of Money:** Time line - Compounding techniques - present value techniques - Solving for interest rate and time - Future value and present value of an annuity - Solving Interest rate - Number of periods or payment for an annuity - perpetuities.

UNIT – II

12 periods

Valuation of Securities: Bond Valuation - Preferred Stock Valuation - Common Stock Valuation - Concept of Yield and YTM. Risk and Return analysis. **Risk & Return:** Defining Risk and Return - Investment returns – Stand alone Risk and portfolio risk - Calculation of Beta coefficient -Using Probability Distributions to Measure Risk - Attitudes Toward Risk - Risk and Return in a Portfolio Context - Diversification - The Capital Asset Pricing Model (CAPM)

UNIT – III

11 periods

Operating & Financial Leverage: Operating Leverage - Financial Leverage - Total Leverage - Indifference Analysis in leverage study. **Cost of Capital:** Concept - Computation of Specific Cost of Capital for Equity - Preference - Debt - Weighted Average Cost of Capital - Factors affecting Cost of Capital 4L. **Capital Budgeting :** The Capital Budgeting Concept & Process - An Overview - Generating Investment Project Proposals - Estimating Project - After Tax Incremental Operating Cash Flows - Capital Budgeting Techniques - Project Evaluation and Selection - Alternative Methods

UNIT – IV

11 periods

Working Capital Management: Overview - Working Capital Issues - Financing Current Assets (Short Term and Long Term- Mix) - Combining Liability Structures and Current Asset Decisions - Estimation of Working Capital. **Cash Management:** Motives for Holding cash - Speeding Up Cash Receipts - Slowing Down Cash Payouts - Electronic Commerce - Outsourcing - Cash Balances to maintain - Factoring. **Accounts Receivable Management:** Credit & Collection Policies - Analyzing the Credit Applicant - Credit References - Selecting optimum Credit period.

TEXT BOOK

1. Prasanna Chandra, *Fundamentals of Financial Management*, Tata McGraw Hills, New Delhi, Fourth Edition, 2011.

REFERENCES

1. M.Y.Khan & P.K. Jain, *Theory and Problems in Financial Management*, Tata McGraw Hills, New Delhi, Fifth Edition, 2011.
2. R.K. Sharma and Shashi K.Gupta, *Financial Management Theory and Practice*, Kalyani publishers, New Delhi, First Edition, 2014.
3. S.N. Maheshwari, *Financial Management, Principles and practice*, Sultan Chand & Sons, New Delhi, Third Edition, 2014.
4. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., Noida and New Delhi, Eleventh Edition, 2015.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit - I	<ul style="list-style-type: none"> List out the basics of financial managerial applications for a modern business. Illustrate the value of money, deposits, loans, applying different tools
Unit - II	<ul style="list-style-type: none"> Determine the value of financial securities using different models
Unit - III	<ul style="list-style-type: none"> Experiment the different techniques for calculating the cost of the capitals in modern firms. Examine and evaluate the structures of the present-day firms' capital structure and the optimization.
Unit - IV	<ul style="list-style-type: none"> Understand the Working Capital Management, Cash Management and Accounts Receivable Management techniques

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course Outcome	Knowledge Level
1	Explain the concept of fundamental financial concepts, especially time value of money.	K2
2	Apply capital budgeting projects using traditional methods.	K4
3	Identify the necessity of basics of financial managerial applications for a modern business.	K4
4	Determine the value of money, deposits, loans, applying different tools for the benefit of the individuals and firms.	K5
5	Determine the value of securities applying different tools for the benefit of the individuals and firms.	K3
6	Understand the different techniques of calculating the cost of the capitals in modern firms for the sake of stockholders.	K3
7	Leverage the concept for deciding financial angle of IT projects	K3

L	T	P	C
3	0	0	3

Course Code: MGT211

Semester: VII

FUNDAMENTALS OF HUMAN RESOURCE MANAGEMENT

Course Objectives:

This course will help the learner to understand the basic principles of Human Resource Management to influence the organization's current performance and sustainable growth in the long run. The course will familiarize students with the basic concepts, roles, functional areas and activities of HR to manage the human resources of the organization in the best possible way to achieve the desired business results

UNIT - I

11 Periods

Introduction to Human Resource Management: Concept and Challenges, HR Philosophy, Policies, Procedures and Practices, Changing role of HR managers, , Strategic Human Resource Management ,Managing Diversity in the Workplace, An overview of Human Resource Information System & Human resources audit.

UNIT - II

11 Periods

Human Resource Planning: Acquisition & Development: Human Resource Planning methods, trends and approaches, Talent management issues and challenges service sector, Job analysis process, Job description, Job specification, Recruitment: Internal, External, Internet recruiting, Selection process, Tools for selection, Training and Development: Need analysis, Methods, Evaluation of training, Management Development Programmes, Career planning & Succession Planning.

UNIT – III

12 Periods

Performance Appraisal & Compensation: Performance management- Meaning & importance - Appraisal: Process and Methods. Wage and Salary Administration: Principles and methods, Variable Pay, Performance based pay, Allowances, Total Rewards, pay differentials, external and internal equity person based and skill-based pay, Broad Banding – Overview, Job evaluation: process and Methods, Incentive and Benefits, Executive compensation. Employee Empowerment and Motivation of Service Workers.

UNIT - IV

11 Periods

HR in Service Sector: Role of Service Employee, Service Leadership, Managing the Customer-Employee Interaction, Service Culture in the Organisation, Issues and Challenges of HR in Service sector : Quality of life, Attrition, Retention , Flexible Working Practices.

TEXTBOOKS

1. K Aswathappa, *Human Resource Management*, Mc Graw Hill India, 8th edition, 2017
2. Gary Dessler, *Human Resource Management*, Pearson Education, 14th Edition, 2015

REFERENCES

1. Robert L Mathis, John H Jackson, *Human Resource Management*, Cengage Learning, 2016.
2. Rakhi Bhattacharya, Rajiv S.Mishra *HRM In Service Sector Management*, Himalaya Publications, 2019
3. C. B. Mamoria, S. V. Gankar, *Personnel Management and Industrial Relations*, Himalaya Publications, 2010
4. C. B. Mamoria, Satish Mamoria, S. V. Gankar, *Dynamics of Industrial Relations*, Himalaya Publications, 2012
5. Gupta C.B. *Human Resource Management*, Sultan Chand & Sons, Nineteenth Edition, 2018.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> Understand the global changes and the changing role of HR manager.
Unit II	<ul style="list-style-type: none"> Identify the man power planning and importance of succession plan in the organization
Unit III	<ul style="list-style-type: none"> Assimilate the performance of appraisal methods and compensation designs
Unit IV	<ul style="list-style-type: none"> Understand the issues and challenges of HR in service sector.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course Outcome	Knowledge Level
1	Understand the global changes, competition in the Industry (Political, Economic, Societal & Technological Environment) and to formulate HR Policies, Procedures and Practices to manage diverse workforce	K2
2	Understand the HRM function & the challenges and to use technology and knowledge-based systems for HR functions.	K3
3	Analyse the importance of man specifications (required skill), & job specifications (task duties, responsibilities), through the Manpower planning process and also formulating the KSA (Knowledge, Skills & Abilities) analysis of employees to formulate training & development programmes.	K4
4	Formulate career & succession plans and performance-based appraisal system	K6
5	Handle employee issues and evaluate the new trends, participative culture, flexible work practices, customer- employee interaction and design suitable leadership styles	K5
6	Handle employee issues and evaluate Quality of life and Attrition, Retention issues of Service Sector.	K5

L	T	P	C
0	0	2	1

Course Code: CSE333

Semester: VII

USABILITY DESIGN OF SOFTWARE APPLICATIONS LABORATORY

Course Objectives: This course will enable the learner to enhance their innovation and creative thinking skills in developing web and mobile applications.

1. Installing and running applications on android studio
2. Design an android application to display the text "hello world"
3. Develop an android application to change background color and image
4. Implement a counter App for counting the number of times 'ENTER' key is pressed
5. Create an android application to add 5 images and change the image on button click
6. Design a canteen app using menus, lists and layouts
7. Design a registration form to open a bank account
8. Create a screen that has input boxes for User Name, Password, Address, Gender (radio buttons for male and female), Age (numeric) and a Submit button. On clicking the submit button, print all the data below the Submit Button
9. Design an android application to create page using Intent and one Button and pass the Values from one Activity to second Activity
10. Design an android application to Send SMS via Internet
11. Create an android application using Fragments
12. Develop an application with login and registration page connecting to database

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Illustrate naïve user interaction screens in android studio	K2
2	Demonstrate applications using menus, scroll bars and lists	K3
3	Design user registration forms for various applications	K6
4	Develop applications for sending SMS via Internet	K6
5	Create applications with different layouts using fragments	K6
6	Construct programs to connect user forms and databases	K6

L	T	P	C
0	0	2	1

Course Code: INT319

Semester: VII

IT WORKSHOP SCILAB/MATLAB LABORATORY

Course Objectives:

This course will help the learner to develop applications using machine learning techniques such as supervised and unsupervised learning for classification and clustering.

1. Implementation of Histogram Mapping and Equalization.
2. Implementation of image smoothening Filters.
3. Implementation of image sharpening filters.
4. Visualize dataset using plotting methods.
5. Implementation of image morphology techniques.
6. Implementation of color image processing.
7. Implementation of thresholding methods in medical image segmentation.
8. Implementation of clustering methods in medical image segmentation.
9. Implementation of edge detection methods in object identification.
10. Computation of statistical features such as mean, standard Deviation, correlation coefficient of the given Image
11. Develop a GUI for fruit/vegetable classification.
12. Implementation of deep learning techniques for image classification.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Understand MATLAB commands, toolbox and functions	K2
2	Illustrate the image enhancement techniques	K2
3	Analyze the dataset using various plotting methods	K4
4	Demonstrate the use of image segmentation techniques	K6
5	Understand and apply the classification methods	K3
6	Develop applications for real time problem solving	K6

L	T	P	C
0	0	4	2

Course Code:

Semester: VII

PROJECT PHASE - I

Course Objectives

Project work empowers the learner to

- Understand research articles and technical documents
- Select appropriate scientific and mathematical model based on literature survey to solve the problem
- Develop innovative solutions by applying holistic knowledge and software engineering principles
- Improve Interpersonal skills, including ability to lead and to work cooperatively in a team
- Improve oral and written technical communication skills
- Abide by the legal and ethical standards and catering for social development

Course Description:

The Project work provides the learner an opportunity to apply and extend knowledge acquired throughout the program. Project work can be carried out individually or as a group of two to three persons. It can be carried out either as an in-house project or as an intern at a company or an Institution. This course introduces the dimension of workload management into the program to enable completion of a large, relatively unstructured work

- In the initial stages, the learner is expected to choose a problem, along with the group members. This leads to the formulation of the problem, checking the feasibility of the work to be completed within the given stipulated duration
- The learner analyzes the chosen problem and design computationally efficient optimal algorithms, meeting the requirement specification, so that it leads to building energy efficient Software/Hardware system
- The learner employs advanced tools to implement the methodology by applying project management principles, while keeping in mind the professional ethics, societal and environmental impact
- The learner uses appropriate Software/Hardware testing strategies for the developed system and builds a user friendly interface
- Individual performance of the learner is continuously assessed by periodic reviews of the progress of the project work

COURSE LEARNING OUTCOMES

Upon successful completion of the project, the learner will be able to

- Identify the current societal and technological requirements

- Analyze and discuss the shortfalls of current system by performing literature survey
- Correlate the mathematical, conceptual and computing knowledge with the problem under study, considering uncertainties
- Plan the project development stages and distribute tasks among the team members
- Use technical literature and relevant information sources for designing cost effective solution based on acquired knowledge
- Implement the design by applying computational methods and technical skills using appropriate software tools
- Examine technical uncertainties during system development
- Evaluate the system by using appropriate testing strategies and refine the system through discussions among team members
- Write a report explaining the technical concepts of the developed system
- Apply legal and ethical standards

Project Rubrics:

Component		Marks
Review panel	Review I	30
	Review II	30
	Average	30
Project supervisor's component		20
Total		50

Reviews	Evaluation criteria	Marks
Zeroth Review	Not taken for evaluation	NA
	Students will brief on the area or problem identified by them and shall also discuss on the likely objectives for their chosen project to the review panel. The feasibility of the project (considering technical, time and cost factors) will be ascertained.	
	The problem identified / objectives shall be appropriate for project to be executed by a team or as an individual	
Review I	Problem formulation/ Objective & Motivation/ Literature review or survey	10
	Experimental Design / Mathematical Model / Solution Methodology / Methods & Procedures and so on (Methodology / Work plan)	10
	Work carried out	10
	Total	30
Review II	Design/analysis/experiments/fabrication and following of ethical practices & Results	10

	Interpretation/Understanding, Discussion & Conclusion(s)	20
	Failed attempts shall also be disclosed and learning from failed attempts or negative results are also acceptable	
	Total	30

End Semester Examination	Evaluation criteria	Marks
	Project Report / Thesis	10
	Problem Formulation / Objective & Methods & Processes including experimental design, mathematical model and so on	15
	Results and Discussion	15
	Individual Contribution / Learning and Viva Voce	10
	Total	50

L	T	P	C
3	1	0	4

Course Code: CSE429**Semester: VII**

COGNITIVE SCIENCE & ANALYTICS

Course Objectives

This course explores the area of cognitive computing and its implications for today's world of big data analytics and evidence-based decision making. Topics covered include: cognitive computing design principles, natural language processing, knowledge representation, Students will have an opportunity to build cognitive applications, as well as explore how knowledge-based artificial intelligence and deep learning are impacting the field of data science.

UNIT - I

15 periods

The Foundation Of Cognitive Computing: Cognitive Computing as a New Generation - The Uses of Cognitive Systems - What Makes a System Cognitive? - Gaining Insights from Data - Artificial Intelligence as the Foundation of Cognitive Computing - Understanding Cognition - Two Systems of Judgment and Choice - Understanding Complex Relationships Between Systems - The Elements of a Cognitive System. **Design Principles For Cognitive Systems:** Components of a Cognitive System - Building the Corpus - Bringing Data into the Cognitive System - Machine Learning - Hypotheses Generation and Scoring - Presentation and Visualization Services.

UNIT - II

15 periods

Natural Language Processing In Support Of a Cognitive System: The Role of NLP in a Cognitive System - Semantic Web - Applying Natural Language Technologies to Business Problems. **The Relationship Between Big Data And Cognitive Computing:** Dealing with Human-Generated Data - Defining Big Data - The Architectural Foundation for Big Data - Analytical Data Warehouses – Hadoop - Data in Motion and Streaming Data - Integration of Big Data with Traditional Data. **Representing Knowledge In Taxonomies And Ontologies:** Representing Knowledge - Defining Taxonomies and Ontologies - Explaining How to Represent Knowledge - Models for Knowledge Representation - Implementation Considerations.

UNIT - III

15 periods

Applying Advanced Analytics To Cognitive Computing: Advanced Analytics Is on a Path to Cognitive Computing - Key Capabilities in Advanced Analytics - Using Advanced Analytics to Create Value - Impact of Open Source Tools on Advanced Analytics. **The Role Of Cloud And Distributed Computing In Cognitive Computing:** Leveraging Distributed Computing for Shared Resources - Why Cloud Services Are Fundamental to Cognitive Computing Systems - Characteristics of Cloud Computing - Cloud Computing Models - Delivery Models of the Cloud - Managing Workloads - Security and Governance - Data Integration and Management in the Cloud. **The Business Implications Of Cognitive Computing:** Preparing for Change - Advantages of New Disruptive Models - What Does Knowledge Mean to the Business? - The Difference with a Cognitive Systems Approach - Meshing Data Together Differently - Using Business Knowledge to Plan for the Future - Answering Business Questions in New Ways - Building Business Specific Solutions - Making Cognitive Computing a Reality - How a Cognitive Application Can Change a Market.

UNIT - IV**15 periods**

Building A Cognitive Healthcare Application: Foundations of Cognitive Computing for Healthcare - Constituents in the Healthcare Ecosystem - Learning from Patterns in Healthcare Data - Building on a Foundation of Big Data Analytics - Cognitive Applications across the Healthcare Ecosystem - Starting with a Cognitive Application for Healthcare - Using Cognitive Applications to Improve Health and Wellness - Using a Cognitive Application to Enhance the Electronic Medical Record - Using a Cognitive Application to Improve Clinical Teaching. **Smarter Cities: Cognitive Computing In Government:** How Cities Have Operated - The Characteristics of a Smart City - The Rise of the Open Data Movement Will Fuel Cognitive Cities - The Internet of Everything and Smarter Cities - Understanding the Ownership and Value of Data - Cities Are Adopting Smarter Technology Today for Major Functions - Smarter Approaches to Preventative Healthcare - Building a Smarter Transportation Infrastructure - Using Analytics to Close the Workforce Skills Gap - Creating a Cognitive Community Infrastructure - The Next Phase of Cognitive Cities. **Emerging Cognitive Computing Areas:** Characteristics of Ideal Markets for Cognitive Computing - Vertical Markets and Industries. **Future Applications For Cognitive Computing:** Requirements for the Next Generation - Technical Advancements That Will Change the Future of Cognitive Computing - What the Future Will Look Like - Emerging Innovations

TEXT BOOKS

1. Hurwitz, Kaufman, and Bowles, *Cognitive Computing and Big Data Analytics*, Wiley, Indianapolis, IN, First Edition, 2015.
2. Masood, Adnan, Hashmi, Adnan, *Cognitive Computing Recipes-Artificial Intelligence Solutions Using Microsoft Cognitive Services and TensorFlow*, First Edition, 2015.

REFERENCES

1. Peter Fingar, *Cognitive Computing: A Brief Guide for Game Changers*, PHI Publication, First Edition, 2015.
2. Gerardus Blokdyk, *Cognitive Computing Complete Self-Assessment Guide*, First Edition, 2018.
3. Rob High, Tanmay Bakshi, *Cognitive Computing with IBM Watson: Build smart applications using Artificial Intelligence as a service*, IBM Book Series, First Edition, 2019.

ONLINE MATERIALS

1. <https://www.udemy.com/course/ibm-watson-for-artificial-intelligence-cognitive-computing/>
2. <https://www.edx.org/course/implementation-strategies-ai-and-cognitive-computing>

UNITWISE LEARNING OUTCOMES

After successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Elaborates the perspective on the evolution to cognitive computing from artificial intelligence to machine learning • Understanding of what the architecture of cognitive computing is and how the pieces fit together
Unit II	<ul style="list-style-type: none"> • Explains how a cognitive system uses natural language processing techniques and how these techniques create understanding • Demonstrates the Big Data technologies and approaches that are fundamental to a cognitive system • examines how ontologies provide meaning to unstructured content

Unit III	<ul style="list-style-type: none">Assess meaning of both structured and unstructured content requires the use of a wide range of analytical techniques and tools.Explains the connection between Big Data, cloud services, and distributed analytic services
Unit IV	<ul style="list-style-type: none">Interpret complex data and processes in areas such as healthcare, manufacturing, transportation, retail, and financial servicesIllustrates different applications depending on different application domain

COURSE LEARNING OUTCOMES

After successful completion of the course, the learner will be able to

CO No.	Course Outcomes	Knowledge Level
1	Understand the basics of Cognitive Computing and its differences from traditional Approaches of Computing	K2
2	Plan and use the primary tools associated with cognitive computing	K2
3	Plan and execute a project that leverages Cognitive Computing	K3
4	Develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions	K4
5	Understand how Cognitive computing supports human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.	K4
6	Solve real life problems using cognitive analytics and interpret outcomes of analysis	K3

L	T	P	C
3	1	0	4

Course Code: CSE425

Semester: VII

MACHINE LEARNING ESSENTIALS

Course Objective

This course aims at introducing the basics of Machine Learning, its scope and applications. It further helps the learners to understand and analyze the essential machine learning algorithms to apply in recent trends.

UNIT - I

15 Periods

Introduction: Machine learning: what and why? Supervised learning - Unsupervised learning - Some basic concepts in machine learning. **Mining Frequent Patterns, Associations, and Correlations:** Basic Concepts - Frequent Itemset Mining Methods - Pattern evaluation methods

UNIT - II

15 Periods

Classification: The problem of classification - Feature engineering - Training and testing classifier models - Statistical decision theory. **Classifiers:** Naïve Bayes classification - Bayesian networks - Decision Tree Classifier - Random Forest Classifier - K-Nearest Neighbor classification - Support Vector Machines. **Artificial Neural Networks:** Perceptron - Multilayer Networks and Backpropagation - Applications - Bagging and Boosting - Cross-validation - Model evaluation.

UNIT - III

15 Periods

Hidden Markov Models: Forward-Backward HMM - Viterbi algorithms - Sequence classification - Conditional Random Fields. **Applications:** Part-of-speech tagging. **Regression:** Multi-variable Regression - Least Squares Regression - Regularization - Applications.

UNIT - IV

15 Periods

Clustering: Average Linkage - BIRCH - CURE - Expectation-Maximization, Ward's Algorithm - Minimum Spanning Tree Clustering - DBSCAN - Evaluation of clustering. **Outlier Analysis:** Introduction - Extreme Value Analysis - Probabilistic Models - Clustering for Outlier Detection - Distance- Based Outlier Detection - Density-Based Methods

TEXTBOOKS

1. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
2. C. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
3. Jiawei Han, Micheline Kamber, and Jian Pei. *Data Mining: Concepts and Techniques*, Morgan Kaufman, Third Edition, 2012

REFERENCES

1. Tom M. Mitchell, "Machine Learning", McGraw Hill, 2013.
2. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001.
3. E. Alpaydin, Introduction to Machine Learning, 3/e, Prentice-Hall, 2014.

4. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
5. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">Describe the basics and needs of Machine learningBuild the frequent mining algorithms to extract the useful patterns from the data
Unit II	<ul style="list-style-type: none">Apply and analyze supervised learning algorithmsImplement artificial neural network using single and multilayer perceptron
Unit III	<ul style="list-style-type: none">Evaluate the importance of HMM and demonstrate its applications
Unit IV	<ul style="list-style-type: none">Apply and analyze supervised learning algorithmsOutline the needs of anomaly detection algorithms and illustrates various outlier detection methods

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Explain the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
- Explain the strengths and weaknesses of many popular machine learning approaches.
- Influence the importance of mathematical relationships within and across Machine Learning algorithms and the paradigms of machine learning and deep learning.
- Develop machine learning solutions to classification, regression, and clustering problems and apply various regularization techniques
- Design and implement various machine learning algorithms in a range of real-world applications
- Evaluate and interpret the results of the machine learning algorithms

L	T	P	C
3	1	0	4

Course Code: CSE430

Semester: VII

CRYPTOLOGY

Course Objectives

This course will help the learners to explore the emerging concepts of cryptographic algorithms to prevent the security attacks on information systems

UNIT - I

15 Periods

Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation- Elementary cryptosystems. **Basic Security Services:** Confidentiality – Integrity - Availability, Non-Repudiation - Privacy

UNIT - II

15 Periods

Symmetric Key Cryptosystems: Stream Cipher - Basic Ideas, Hardware and Software Implementations. **Examples with some prominent ciphers:** A5/1 - Grain family - RC4 - Salsa and ChaCha - HC128 - SNOW family – ZUC. **Block Ciphers:** DES – AES – Modes of operation

UNIT – III

15 Periods

Hash Function and Message Authentication: Hash function and data Integrity – Security of hash functions – Iterated hash functions – The sponge construction. **Message Authentication:** Nested MACs and HMACs - unconditionally secure MACs. **Public Key Cryptosystems:** RSA - ECC - Digital Signatures

UNIT – IV

15 Periods

Security Applications: Electronic commerce, Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis. **Post Quantum Cryptography:** Lattice Based Cryptography – Multivariate Cryptography – hash – Based Signature Schemes

TEXTBOOKS

1. Stinson, Douglas R. *Cryptography: theory and practice*, Chapman and Hall/CRC Press, Fourth Edition, 2005.
2. Menezes, Alfred J., Paul C. Van Oorschot, and Scott A. Vanstone. *Handbook of applied cryptography*, CRC Press, First Edition, 1997.
3. William Stallings. *Cryptography and Network Security*, Pearson Education, Seventh Edition, 2017.

REFERENCES

1. Goutam Paul, Subhamoy Maitra, RC4 Stream Cipher and its Variants, CRC Press, First Edition, 2012.
2. Mukherjee, Chandra Sekhar, Dibyendu Roy, and Subhamoy Maitra. *Design and Cryptanalysis of ZUC: A Stream Cipher in Mobile Telephony*. Springer, 2021.
3. Paar, Christof, and Jan Pelzl. *Understanding cryptography: a textbook for students and practitioners*, Springer, 2009.

4. Grzywak, Andrzej, and George Pilch-Kowalczyk. *Quantum Cryptography: Opportunities and Challenges*, Internet Technical Development and Applications, 2009.

ONLINE MATERIALS

1. <https://www.coursera.org/specializations/introduction-applied-cryptography>
2. <https://www.coursera.org/learn/mathematical-foundations-cryptography>

UNITWISE LEARNING OUTCOMES

After successful completion of each unit, the learner will be able to

UNIT I	<ul style="list-style-type: none"> Understand the basic cryptographic techniques Emphasize the concepts of number theory in cryptography
UNIT II	<ul style="list-style-type: none"> Analyse symmetric ciphers, block ciphers and stream ciphers Apply the concepts of encryption algorithms to data security problems
UNIT III	<ul style="list-style-type: none"> Implement the digital signatures and message authentication codes to verify the authenticity of data
UNIT IV	<ul style="list-style-type: none"> Deploy cryptographic algorithms in various security applications for secure communication Infer the key concepts of quantum cryptography to develop secure encryption algorithms

COURSE LEARNING OUTCOMES

After successful completion of the course, the learner will be able to

CO No.	Course Outcomes	Knowledge Level
1	Learn the fundamental theorems, mathematical concepts and cryptographic algorithms	K2
2	Describe the suitable cryptographic models to resolve data security problems	K3
3	Demonstrate the use of ciphers to ensure secure communication	K4
4	Analyse diverse public-key cryptosystems and authentication	K3
5	Illustrate the importance of enforcing security designs and principles	K2
6	Develop post-quantum cryptography-based secure systems for enhancing information security	K4

L	T	P	C
3	1	0	4

Course Code:

Semester: VII

QUANTUM COMPUTATION & QUANTUM INFORMATION

Course Objectives:

The course will help the learner to understand the basic principles of quantum computing and fundamental differences between conventional computing and quantum computing. The course will provide an information theoretic approach with several basic quantum computing algorithms along with the classes of problems that can be realized by quantum computers.

UNIT-I

15 Periods

Introduction to Quantum Information: States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits.

UNIT-II

15 Periods

Quantum Algorithms: Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems, Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems.

UNIT-III

15 Periods

Quantum True Random Number Generators (QTRNG): Classification of random number generator - Pseudo and true random number generators - Detailed design and issues of quantumness, Commercial products and applications.

UNIT-IV

15 Periods

Quantum key distribution (QKD): Functional security objectives, QKD module specification, Physical security, BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products.

TEXTBOOKS

1. A. Nielsen and I. L. Chuang, *Quantum Computation and Quantum Information*. M. Cambridge University Press, Tenth edition, 2010.
2. Presskil Lecture notes: Available online:
<http://www.theory.caltech.edu/~preskill/ph229/>

REFERENCES

1. P. Kaye, R. Laflamme, and M. Mosca, *An Introduction to Quantum Computing*. Oxford University Press, New York, 2007.
2. N. David Mermin, *Quantum Computer Science*, Cambridge University Press, 2007
3. Tharrmashastha, D. Bera, A. Maitra and S. Maitra, *Quantum Algorithms for*

Cryptographically Significant Boolean Functions - An IBMQ Experience. Springer, 2020.

4. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, *Handbook of Applied Cryptography*. CRC press, 2018.

ONLINE MATERIALS

1. https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/
2. <https://csrc.nist.gov/projects/post-quantum-cryptography/round-2-submissions>
3. <https://quantumalgorithmzoo.org/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> Understand the basic building blocks of Quantum computation, Quantum information and super dense coding Relate the concepts of quantum entanglement to achieve quantum teleportation
Unit II	<ul style="list-style-type: none"> Enable the study of quantum algorithms based on Fourier transform and to perform quantum searching Interpret the implications of quantum algorithms with Symmetric Key Cryptosystems (SKC) and Public Key Cryptosystems (PKC).
Unit III	<ul style="list-style-type: none"> Analyze the design issues of quantumness with respect to QTRNG Relate QTRNG with commercial applications
Unit IV	<ul style="list-style-type: none"> Explore the need for Quantum key distribution protocols and their variants Synthesize the quantum information with quantum cryptography to provide secure communications

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course outcomes	Knowledge Level
1	Understand the basic building blocks of Quantum computation, Quantum information and super dense coding	K2
2	Relate the concepts of quantum entanglement to achieve quantum teleportation	K3
3	Enable the study of quantum algorithms based on Fourier transform and to perform quantum searching	K2
4	Interpret the implications of quantum algorithms with Symmetric Key Cryptosystems (SKC) and Public Key Cryptosystems (PKC).	K3
5	Analyze the design issues of quantumness with respect to QTRNG and relate QTRNG with commercial applications.	K3
6	Explore the need for Quantum key distribution protocols and synthesize the quantum information with quantum cryptography to ensure secure communications.	K3

L	T	P	C
3	1	0	4

Course Code: INT317**Semester: VII****DATA MINING AND ANALYTICS****Course Objectives**

This course will help the learner to understand basic concepts and techniques of data mining, apply statistical analysis techniques and develop skills of using data mining software for solving practical problems.

UNIT - I**15 Periods**

Introduction to Data Mining: What is data mining? - Related technologies - Machine Learning - DBMS - OLAP - Statistics - Stages of the Data Mining Process - Data Mining Techniques- Knowledge Representation Methods - Applications **Data preprocessing:** Data cleaning - Data transformation - Data reduction - Discretization and generating concept hierarchies - Installing Weka 3 Data Mining System - Experiments with Weka - filters - discretization. **Data mining knowledge representation:** Task relevant data - Background knowledge - Representing input data and output knowledge - Visualization techniques. **Attribute-oriented analysis:** Attribute generalization - Attribute relevance - Class comparison - Statistical measures

UNIT - II**15 Periods**

Data mining algorithms - Association rules: Motivation and terminology - Example: mining weather data - Basic idea: item sets - Generating item sets and rules efficiently - Correlation analysis **Data mining algorithms - Classification:** Basic learning/mining tasks - Inferring rudimentary rules: 1R algorithm - Decision trees - covering rules **Data mining algorithms - Prediction:** The prediction task - Statistical (Bayesian) classification - Bayesian networks - Instance-based methods (nearest neighbor) - linear models

UNIT - III**15 periods**

Descriptive analytics: Data Modeling - Trend Analysis - Simple Linear Regression Analysis **Forecasting models:** Heuristic methods - predictive modeling and pattern discovery - Logistic Regression: Logit transform - ML estimation - Tests of hypotheses - Wald test - LR test - score test - test for overall regression - multiple logistic regression - forward, backward method -interpretation of parameters - relation with categorical data analysis. Interpreting Regression Models - Implementing Predictive Models **Generalized Linear model:** Link functions such as Poisson - binomial - inverse binomial - inverse Gaussian - Gamma. **Non-Linear Regression (NLS):** Linearization transforms, their uses & limitations - examination of non-linearity - initial estimates - iterative procedures for NLS - grid search - Newton-Raphson - steepest descent - Marquardt's methods. Introduction to semiparametric regression models - additive regression models - Introduction to nonparametric regression methods

UNIT - IV**15 periods**

Time Series Analysis: Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt - Winter smoothing, forecasting based on smoothing **Linear time series models:** Autoregressive - Moving Average - Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARMA models such as Yule-Walker estimation for AR Processes - Maximum likelihood and least squares estimation for ARMA Processes - Forecasting using ARIMA models

Prescriptive Analytics: Mathematical optimization, Networks modelling - Multi-objective optimization-Stochastic modelling- Decision and Risk analysis - Decision trees.

TEXT BOOKS

1. Jiawei Han, Micheline Kamber, and Jian Pei. *Data Mining: Concepts and Techniques*, Morgan Kaufman, Third Edition, 2012.
2. Lior Rokach and Oded Maimon, *Data Mining and Knowledge Discovery Handbook*, Springer, Second Edition, 2010.
3. Box, G.E.P and Jenkins G.M. *Time Series Analysis, Forecasting and Control*, Holden-Day, First Edition, 1970.

REFERENCES

1. Draper, N. R. and Smith, H. *Applied Regression Analysis*, Third Edition, John Wiley, 1998.
2. Hosmer, D. W. and Lemeshow, S. *Applied Logistic Regression*, Second Edition, John Wiley, 1989.

ONLINE MATERIAL

1. <https://nptel.ac.in/courses/106105174/>
2. <https://nptel.ac.in/courses/106/107/106107220/>
3. <https://nptel.ac.in/courses/110/106/110106072/>

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Describe the basics of data mining techniques and knowledge representation • Evaluate preprocessing techniques for sample data
Unit II	<ul style="list-style-type: none"> • Illustrate frequent patterns from data • Analyze data mining functionality such as classification and prediction
Unit III	<ul style="list-style-type: none"> • Apply any kind of forecasting model and generalized linear model for descriptive analytics • Modeling real world data for regression analysis
Unit IV	<ul style="list-style-type: none"> • Choose data mining techniques to other kinds of data such as text data and time series data • Use descriptive analytics to handle a variety of business problems • Solve linear time series models and interpret their results for effective decision making • Use descriptive analytic techniques to handle a variety of business problems

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

- Evaluate preprocessing techniques on data of a given task.
- Illustrate frequent item sets and patterns from any structured data
- Compare different classification and prediction techniques
- Demonstrate an ability to select the most appropriate data mining technique for particular problems
- Build and solve linear and non-linear models and interpret their results for effective decision making
- Apply regression analysis and forecasting techniques to characterise relationships among business variables, identify patterns in data and predict future trends.

L	T	P	C
3	1	0	4

Course Code: INT404
Semester: VII

MOBILE COMMUNICATIONS

Course Objectives:

This course will help the learner to comprehend the wireless communication technologies for mobile portable devices and the mechanisms for location and handoff management, routing in mobile IP. It also helps the learner to understand the recent technology developments in mobile communications

UNIT - I

13 Periods

Introduction: Evolution of wireless communication systems - Radio propagation attenuation - basic propagation mechanisms - mobile radio channel - propagation models - Free-space - Point-to-Point - Outdoor and indoor propagation - signal attenuation due to Foliage - Long distance propagation - Principles of Cellular Communication - Cellular terminology - Cell Structure and Cluster - Frequency Reuse Concept - Cluster Size and System Capacity - Locating co-channel cells - Frequency reuse distance - cochannel interference and signal quality - co-channel interference reduction methods- Frequency Management - Channel Assignment strategies - Fixed - dynamic - hybrid - Parameters to increase cell coverage, reduce interference and increase traffic capacity - Cell Splitting

UNIT - II

15 Periods

Location and Handoff Management: GSM - GSM Services - GSM Architecture - GSM Security - GPRS - GPRS Services - GPRS Architecture - Mobility models characterizing individual node movement: Random walk - Fluid flow - Markovian - Activity based - Mobility models characterizing the movement of groups of nodes: Reference point based group mobility model - Community based group mobility model - Static location management schemes: Always vs. Never update - Reporting Cells - Location Areas - Dynamic location management schemes: - Time Based - Movement Based - Distance Based - Profile Based - Terminal Paging: Simultaneous paging - Sequential paging - Location management and Mobile IP: Overview of handoff process - Factors affecting handoffs - Performance evaluation metrics - Handoff strategies: soft - hard - horizontal - vertical

UNIT - III

15 Periods

Wireless transmission fundamentals: Motivation for a specialized MAC - SDMA - FDMA - TDMA - Spread Spectrum - Frequency Hopping Spread Spectrum - Direct Sequence Spread Spectrum - CDMA - Introduction to MIMO - MIMO Channel Capacity and diversity gain - Introduction to OFDM - MIMO-OFDM system - Wireless local area network - IEEE802.11 - Protocol Architecture - MAC - Wireless personal area network - Bluetooth - Architecture - Physical Layer - Baseband Layer - Link Manager Protocol - zigbee - Architecture - Physical Layer - MAC Layer - Security - Frame Structures

UNIT - IV

17 Periods

Mobile Ad-hoc networks: Characteristics - Applications - Design issues - routing protocols - DSDV - DSR - AODV - ZRP. **Wireless sensor networks:** Applications - Architecture - Challenges - Characteristics - Routing in WSN - Classification - Directed Diffusion - Rumor Routing - SAR - LEACH. **Cognitive radio networks:** Fixed and dynamic spectrum access - Direct and indirect spectrum sensing - Spectrum sharing - Interoperability and co-existence issues - Applications of cognitive radio networks. **D2D communications in 5G cellular networks:** Introduction to D2D

communications - High level requirements for 5G architecture - Introduction to the radio resource management - power control and mode selection problems - Millimeter wave communication in 5G.

TEXTBOOKS

3. T L Singal, *Wireless Communications*, Tata McGraw Hill Publications, First Edition, 2010
4. Prasant Kumar Pattnaik and Rajib Mall, *Fundamentals of Mobile Computing*, Prentice Hall of India, Second Edition, 2016.
5. Cory Beard, William Stallings, *Wireless Communication Networks and Systems*, Pearson Education, Global Edition, 2015
6. H. Labiod, H. Afifi, C. De Santis, *WI-FI™, BLUETOOTH™, ZIGBEE™, and WIMAX™*, Springer, 2007.

REFERENCES

1. Ivan Stojmenovic, *Handbook of Wireless Networking and Mobile Computing.*, Wiley, 2002
2. James Cowling, *Dynamic Location Management in Heterogeneous Cellular Networks*, Thesis submitted to Advanced Networks Research Group, School of Information Technologies, University of Sydney, Australia, 2004.
3. Travis Keshav, Location Management in Wireless Cellular Networks, https://www.cse.wustl.edu/~jain/cse574-06/ftp/cellular_location/index.html
4. Sana Zeba Bakshi, Sadiya Mirza, *MIMO COMMUNICATIONS*, International Research Journal of Engineering and Technology, Vol. 04, Issue12, Dec-2017
5. Lingyang Song, Dusit Niyato, Zhu Han, and Ekram Hossain, *Wireless Device-to- Device Communications and Networks*. Cambridge University Press, 2015
6. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan Mandayam and H. Vincent Poor, *Principles of Cognitive Radio*, Cambridge University Press. 2013

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> Comprehend radio propagation mechanisms Choose appropriate cell size, capacity and channel assignment policy
Unit II	<ul style="list-style-type: none"> Choose appropriate location update mechanism and handoff strategy Employ mobility models to predict the node movement
Unit III	<ul style="list-style-type: none"> Choose appropriate modulation, multiplexing and multiple access strategies Comprehend Bluetooth and Zigbee architecture and protocol stack
Unit IV	<ul style="list-style-type: none"> Choose appropriate routing protocol for ad hoc network Comprehend Cognitive radio and D2D communication in 5G cellular network

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Comprehend radio propagation mechanisms	K2
2	Choose appropriate cell size, capacity, channel assignment policy, location update mechanism and handoff strategy	K3
3	Employ mobility models to predict the node movement	K3
4	Choose appropriate modulation, multiplexing, multiple access strategies, and routing protocol for mobile ad hoc network	K3
5	Comprehend Bluetooth and Zigbee architecture and protocol stack	K2
6	Comprehend Cognitive radio and D2D communication in 5G cellular network	K2

L	T	P	C
3	1	0	4

Course Code:

Semester: VIII

SERVICES SCIENCE & SERVICE OPERATIONS MANAGEMENT

Course Objectives:

This course aims at providing a perspective on the concepts, framework & analytical procedures available to service business to resolve the varied challenges faced in different situations.

UNIT - I

15 Periods

Introduction to Services : Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. **Nature of Services and Service Encounters:** Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters. **Service-Dominant Logic:** From Goods-Dominant logic to Service-Dominant logic, Value Co-creation

UNIT - II

16 Periods

Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis. **New Service Development:** NSD cycle, Service Blueprinting, Elements of service delivery system. **Service Design:** Customer Journey and Service Design, Design Thinking methods to aid Service Design. **Locating facilities and designing their layout:** models of facility locations (Huff's retail model), Role of service-scape in layout design. **Complaint handling & Service recovery:** Customer complaining behavior, Customer responses to effective service recovery, Service guarantees. Discouraging abuse and opportunistic customer behavior

UNIT – III

14 Periods

Balancing Demand and Capacity: Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services. **Forecasting Demand for Services:** A review of different types of forecasting methods. **Managing service supply relationship:** Understanding the supply chain/hub of service, Strategies for managing suppliers of service. **Vehicle Routing Problem:** Managing after sales service, understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes. **Managing service supply relationship:** Understanding the supply chain/hub of service, Strategies for managing suppliers of service. **Managing Facilitating Goods:** Review of inventory models, Role of inventory in services

UNIT - IV

15 Periods

Striving for service excellence: Improving Service quality and productivity. **Service Quality:** SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools. **Designing and measuring productivity.** Improving service productivity. **Building a world class service organization:** Creating a world class service organization, Customer satisfaction and corporate performance.

TEXTBOOK

1. Fitzsimmons & Fitzsimmons, *Service Management: Operations, Strategy, Information Technology*, McGraw Hill publications, Seventh Edition, 2017.

REFERENCES

1. Christopher Lovelock, Jochen Wirtz, Jayanth Chatterjee, *Services Marketing*, Pearson Education Asia, Eighth Edition, 2021.
2. Robert Johnston Graham Clark Michael Shulver, *Service operations Management*, Pearson, Fourth Edition, 2012.
3. John E.G.Bateson, K.Douglas Hoffman, *Services Marketing*, Cengage Learning, Fourth Edition, 2011.
4. Rama Mohana Rao K, *Services Marketing*, Pearson, Second Edition, 2011.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> Understand the nature of services, service operations and differences between service sector and manufacturing sector
Unit II	<ul style="list-style-type: none"> Identify the elements of service delivery system and customer complaining behaviour
Unit III	<ul style="list-style-type: none"> Analyse how capacity can meet demand and various inventory models
Unit IV	<ul style="list-style-type: none"> Understand the issues and challenges of productivity and service quality and also how to build a world class service organization

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to

CO No.	Course Outcome	Knowledge Level
1	Familiarize and understand the basic aspects of services and service operations	K2
2	Develop the service design with apt service delivery elements and analyse the service recovery process	K5
3	Analyse the relevance of balancing demand and productive capacity in service sectors	K4
4	Evaluate the challenges of revenue management in services	K5
5	Understand the ways of creating world class service organization	K2

L	T	P	C
2	1	0	3

Course Code:

Semester: VIII

IT PROJECT MANAGEMENT

Course Objectives:

This course will help the learner to understand the key aspects of software projects, the strategies required for managing projects from their birth to completion, agile project management techniques such as Scrum and DevOps.

UNIT - I

12 Periods

Project Overview and Feasibility Studies: Identification of Market and Demand Analysis, Project Cost Estimate, Financial Appraisal. **Project Scheduling:** Introduction to PERT and CPM - Critical Path Calculation - Precedence Relationship - Difference between PERT and CPM - Float Calculation and its importance - Cost reduction by Crashing of activity.

UNIT - II

11 Periods

Cost Control and Scheduling: Project Cost Control (PERT/Cost) - Resource Scheduling & Resource Leveling. **Project Management Features:** Risk Analysis - Project Control - Project Audit and Project Termination.

UNIT – III

11 Periods

Agile Project Management: Introduction to Agile Principles and Agile methodologies - Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL). **Scrum:** Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective) - Various Scrum roles - Best practices of Scrum.

UNIT - IV

11 Periods

DevOps: Overview and its Components - Containerization Using Docker - Managing Source Code and Automating Builds - Automated Testing and Test Driven Development - Continuous Integration and Configuration Management - Continuous Deployment - Automated Monitoring. **Other Agile Methodologies:** Introduction to XP, FDD, DSDM & Crystal.

TEXTBOOKS

1. Mike Cohn, *Succeeding with Agile: Software Development Using Scrum*, Addison-Wesley, 2010
2. Rossberg, Joachim. *Agile Project Management with Azure DevOps: Concepts, Templates, and Metrics*. Germany, Apress, 2019.

REFERENCES

1. Roman Pichler, *Agile Product Management with Scrum*, Addison-Wesley Professional, 2010
2. Mark C. Layton, Steven J. Ostermiller, *Agile Project Management For Dummies*, Wiley, 2017
3. Rubin, Kenneth S. *Essential Scrum: A Practical Guide to the Most Popular Agile Process*. United Kingdom, Addison-Wesley, 2012.

4. Ken Schwaber, *Agile Project Management with Scrum (Microsoft Professional)*, Microsoft Press, 2004

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> Compare and contrast the different methods of demand analysis and the impact of errors in operating cost forecast Decide why and when to carry out a financial feasibility analysis and plan the project timeline using PERT and CPM
Unit II	<ul style="list-style-type: none"> Accomplish situational assessment on resource levelling and crashing procedure for project completion Develop proper audit and design project plan to foresee possible sources of risk and completion delay
Unit III	<ul style="list-style-type: none"> Compare lean and scrum methodology principles Implement agile software development using the scrum framework
Unit IV	<ul style="list-style-type: none"> Discover a powerful automation DevOps platform Implement DevOps project Management

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Articulate feasibility study and frame project milestones considering critical activities using PERT and CPM	K2
2	Ensure time, cost and resource estimates are unbiased and reliable	K2
3	Develop an audit approach with regular review reports to ensure the assurance of project completion.	K3
4	Create and use scrum artifacts in agile project management	K3
5	Use Devops and Agile in tandem to streamline project development and management	K3

L	T	P	C
3	0	0	3

Course Code:

Semester: VIII

MARKETING RESEARCH & MARKETING MANAGEMENT

Course Objectives:

This course will help the learner to understand the Marketing concepts and strategies to leverage them for effective decision-making and also the basic concepts and application of statistical tools in Marketing research

UNIT – I

12 Periods

INTRODUCTION TO MARKETING: Marketing Concepts and Applications: Introduction to Marketing & Core Concepts - Marketing of Services - Importance of marketing in service sector. **Marketing Planning & Environment:** Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social. **Understanding the consumer:** Determinants of consumer behavior - Factors influencing consumer behavior. **Market Segmentation:** Meaning & Concept - Basis of segmentation - selection of segments, Market Segmentation strategies - Target Marketing - Product Positioning.

UNIT – II

13 Periods

MARKETING STRATEGIES: Product Management: Product Life cycle concept, New Product development & strategy - Stages in New Product development - Product decision and strategies - Branding & packaging. **Pricing, Promotion and Distribution Strategy:** Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix - Advertising & Publicity - 5 M's of Advertising Management Marketing Channels – Retailing - Marketing Communication - Advertising

UNIT –III

10 Periods

MARKETING RESEARCH AND DATA ANALYSIS: Marketing Research: Introduction, Type of Market Research, Scope, Objectives & Limitations. Marketing Research Techniques - Survey Questionnaire design & drafting - Pricing Research, Media Research, Qualitative Research. **Data Analysis:** Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning - Factor Analysis.

UNIT – IV

10 Periods

INTERNET AND B2B MARKETING: Internet Marketing: Introduction to Internet Marketing - Mapping fundamental concepts of Marketing (7Ps, STP) - Strategy and Planning for Internet Marketing. **Business to Business Marketing:** Fundamental of business markets. Organizational buying process - Business buyer needs - Market and sales potential - Product in business markets - Price in business markets - Place in business markets - Promotion in business markets - Relationship, networks and customer relationship management - Business to Business marketing strategy.

TEXTBOOKS

1. Philip Kotler, Gary Armstrong, *Principles of Marketing Management*, Pearson Education, Seventeenth Edition, 2018
2. GC Beri, Arun Kaushik, Zillur Rahman, *Marketing research*, McGraw Hill, Sixth edition, 2020.

REFERENCES

1. Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithileswar Jha, *Marketing Management*, Pearson Education, Twelfth edition, 2015
2. William J. Stanton et al., *Fundamentals of Marketing*, Tata McGraw Hill, Fourteenth edition, 2007.
3. Rajendra Nargundkar, *Marketing research*, McGraw Hill, Fourth edition, 2019.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit-I	<ul style="list-style-type: none"> Understand the definition, concepts and strategies of marketing
Unit-II	<ul style="list-style-type: none"> Apply the strategies across the marketing mix elements to specific contexts
Unit-III	<ul style="list-style-type: none"> Understand the basics of marketing research Analyse data using various statistical tools and techniques
Unit-IV	<ul style="list-style-type: none"> Understand the concepts and strategies relating to internet and business-to-business marketing

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Understand the conceptual and contextual aspects of marketing research	K2
2	Apply the concepts to specific situations and analyse the outcomes	K3
3	Apply relevant statistical tools and interpret the results to take informed decisions in marketing	K3
4	Understand the concepts and strategies relating to internet and business-to-business marketing	K3

L	T	P	C
0	0	8	4

Course Code:
Semester: VIII

PROJECT PHASE - II

Course Objectives

Project work empowers the learner to

- Understand research articles and technical documents
- Select appropriate scientific and mathematical model based on literature survey to solve the problem
- Develop innovative solutions by applying holistic knowledge and software engineering principles
- Improve Interpersonal skills, including ability to lead and to work cooperatively in a team
- Improve oral and written technical communication skills
- Abide by the legal and ethical standards and catering for social development

Course Description:

The Project work provides the learner an opportunity to apply and extend knowledge acquired throughout the program. Project work can be carried out individually or as a group of two to three persons. It can be carried out either as an in-house project or as an intern at a company or an Institution. This course introduces the dimension of workload management into the program to enable completion of a large, relatively unstructured work

- In the initial stages, the learner is expected to choose a problem, along with the group members. This leads to the formulation of the problem, checking the feasibility of the work to be completed within the given stipulated duration
- The learner analyzes the chosen problem and design computationally efficient optimal algorithms, meeting the requirement specification, so that it leads to building energy efficient Software/Hardware system
- The learner employs advanced tools to implement the methodology by applying project management principles, while keeping in mind the professional ethics, societal and environmental impact
- The learner uses appropriate Software/Hardware testing strategies for the developed system and builds a user friendly interface
- Individual performance of the learner is continuously assessed by periodic reviews of the progress of the project work

COURSE LEARNING OUTCOMES

Upon successful completion of the project, the learner will be able to

- Identify the current societal and technological requirements
- Analyze and discuss the shortfalls of current system by performing literature survey
- Correlate the mathematical, conceptual and computing knowledge with the problem under study, considering uncertainties
- Plan the project development stages and distribute tasks among the team members
- Use technical literature and relevant information sources for designing cost effective solution based on acquired knowledge

- Implement the design by applying computational methods and technical skills using appropriate software tools
- Examine technical uncertainties during system development
- Evaluate the system by using appropriate testing strategies and refine the system through discussions among team members
- Write a report explaining the technical concepts of the developed system
- Apply legal and ethical standards

Project Rubrics:

Component		Marks
Review panel	Review I	30
	Review II	30
	Average	30
Project supervisor's component		20
Total		50

Reviews	Evaluation criteria	Marks
Zeroth Review	Not taken for evaluation	NA
	Students will brief on the area or problem identified by them and shall also discuss on the likely objectives for their chosen project to the review panel. The feasibility of the project (considering technical, time and cost factors) will be ascertained.	
	The problem identified / objectives shall be appropriate for project to be executed by a team or as an individual	
Review I	Problem formulation/ Objective & Motivation/ Literature review or survey	10
	Experimental Design / Mathematical Model / Solution Methodology / Methods & Procedures and so on (Methodology / Work plan)	10
	Work carried out	10
	Total	30
Review II	Design/analysis/experiments/fabrication and following of ethical practices & Results	10
	Interpretation/Understanding, Discussion & Conclusion(s)	20
	Failed attempts shall also be disclosed and learning from failed attempts or negative results are also acceptable	
	Total	30

End Semester Examination	Evaluation criteria	Marks
	Project Report / Thesis	10
	Problem Formulation / Objective & Methods & Processes including experimental design, mathematical model and so on	15
	Results and Discussion	15
	Individual Contribution / Learning and Viva Voce	10
	Total	50

L	T	P	C
3	1	0	4

Course Code:

Semester: VIII

IMAGE PROCESSING AND PATTERN RECOGNITION

Course Objectives

The objective of this course is to equip students with various principles and methods of image processing and pattern recognition. The course includes detailed study of image formation, feature detection and matching, segmentation and recognition. It also introduces students to different colour image models and colour image processing.

UNIT - I

14 periods

Introduction: Image processing systems and its applications. Basic image file formats

Image formation: Geometric and photometric models - Digitization - sampling, quantization - Image definition and its representation, neighbourhood metrics.

UNIT - II

16 periods

Intensity transformations and spatial filtering: Enhancement, contrast stretching, histogram specification, local contrast enhancement - Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG.

Segmentation: Pixel classification - Grey level thresholding, global/local thresholding - Optimum thresholding - Bayes analysis, Otsu method - Derivative based edge detection operators, edge detection/linking, Canny edge detector - Region growing, split/merge techniques, line detection, Hough transform.

UNIT - III

16 periods

Image/Object features extraction: Textural features - gray level co-occurrence matrix - Moments - Connected component analysis - Convex hull - Distance transform, medial axis transform, skeletonization/thinning, shape properties.

Registration: Mono-modal/multimodal image registration - Global/local registration - Transform and similarity measures for registration - Intensity/pixel interpolation.

UNIT - IV

14 periods

Colour image processing: Fundamentals of different colour models - RGB, CMY, HSI, YCbCr, Lab - False colour - Pseudo colour - Enhancement - Segmentation.

Morphological Filtering Basics: Dilation and Erosion Operators, Top Hat Filters

TEXT BOOK

1. R. C. Gonzalez and R. E. Woods, *Digital Image Processing*, Prentice Hall, Fourth edition, 2018.

REFERENCES

1. Maria Petrou and Panagiota Bosdogianni, *Image Processing: The Fundamentals*, Second edition, John Wiley & Sons, Ltd, 2010.
2. K. R. Castleman, *Digital Image Processing*, Prentice Hall, Englewood Cliffs, 1996.
3. A. Blake and A. Zisserman, *Visual Reconstruction*, MIT Press, 1987.
4. A. N. Netravali and B. G. Haskell, *Digital Pictures*, Plenum Press, Second edition, 1995.
5. A. B. Watson, *Digital Images and Human Vision*, MIT Press, 2002.

ONLINE MATERIALS

1. https://onlinecourses.nptel.ac.in/noc21_ee79/preview
2. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

UNITWISE LEARNING OUTCOMES

After successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Explain the image processing systems and its application • Demonstrate the image formation models and ways of its representation
Unit II	<ul style="list-style-type: none"> • Interpret the image enhancement techniques by means of transformations and filtering • Apply segmentation techniques to divide image into parts
Unit III	<ul style="list-style-type: none"> • Utilize image registration techniques for spatial alignment of a pair of views of a scene
Unit IV	<ul style="list-style-type: none"> • Illustrate different colour models • Analyse image using morphological techniques

COURSE LEARNING OUTCOMES

After successful completion of the course, the learner will be able to

CO No.	Course Outcomes	Knowledge Level
CO1	Elaborate the basics of image formation and fundamentals of digital image processing, such as digitization, sampling, quantization.	K2
CO2	Show enhancement on images using the techniques of smoothing, sharpening and enhancement.	K2
CO3	Determine the regions of common property within an image (segmentation) and subsequent identification of such regions by means of feature extraction	K3
CO4	Illustrate the image registration process by transforming different sets of data into one coordinate system	K4
CO5	Explain the abstract mathematical models of colour image processing	K3
CO6	Examine the image based on the broad set of morphological image processing operations	K4

L	T	P	C
3	1	0	4

Course Code:

Semester: VIII

COMPUTATIONAL FINANCE & MODELING

Course Objectives:

This course will help the learner to understand financial models quantitatively and solve complex problems in the area of financial engineering and risk management.

UNIT - I

12 Periods

Stochastic Processes in Discrete Time: - Binomial Processes - Trinomial Processes - General Random Walks - Geometric Random Walks - Binomial Models with State Dependent Increments

Boundary Conditions: American Options as Free Boundary Problems - Early-Exercise Curve - Free Boundary Problem - Black-Scholes Inequality - Obstacle Problem - Linear Complementarity for American Put Options - Multifactor Models

Black-Scholes Option Pricing Model: Black-Scholes Differential Equation - Black-Scholes Formula for European Options - Numerical Approximation - Simulation - Linear Congruential Generator

UNIT - II

18 Periods

Foundations: Principles of Monte Carlo - Principles of Derivatives Pricing

Generating Random Numbers and Random Variables: - Random Number Generation - Random Number Generation - General Considerations - Linear Congruential Generators - Implementation of Linear Congruential Generators - A Jump-Diffusion Model

Forward Rate Models: Continuous Rates

UNIT – III

12 Periods

Risk Management and Hedging: Delta Hedging - Gamma and Theta – Rho and Vega - Volga and Vanna - Historical and Implied Volatility - Realised Volatility

Pricing American Options:- Problem Formulation - Parametric Approximations - Random Tree Methods - High Estimator - Low Estimator – Implementation

UNIT – IV

18 Periods

Applications in Risk Management: - Loss Probabilities and Value-at-Risk - Variance Reduction Using the Delta-Gamma Approximation - A Heavy-Tailed Setting - Credit Risk

TEXTBOOKS

1. Paul Glasserman, *Monte Carlo Methods in Financial Engineering*, Springer - Verlag, New York, First edition, 2003
2. Jürgen Franke, Wolfgang K. Härdle, Christian M. Hafner, *Statistics of Financial Markets - An Introduction*, Springer, Second edition, 2008
3. Rüdiger U. Seydel, *Tools for Computational Finance*, Springer - Verlag, New York, Fifth edition, 2012

REFERENCES

1. Antoon Pelsser, *Efficient Methods for Valuing Interest Rate Derivatives*, Springer, First edition, 2000
2. David Ruppert, David S. Matteson, *Statistics and Data Analysis for Financial Engineering - with R examples*, Springer - Verlag, New York, Second edition, 2015
3. W. Press, S. Teukolsky, W. Vetterling, B. Flannery, *Numerical Recipes in C: The Art of Scientific Computing*, Cambridge University Press, Second edition, 1997

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Explain stochastic processes related to processes and random walks • Solve boundary problems and analyze multifactor models
Unit II	<ul style="list-style-type: none"> • Describe principles of monte-carlo and derivatives pricing • Explain random number generators and the models
Unit III	<ul style="list-style-type: none"> • Solve problems arising in risk management • Comprehend the pricing of American options
Unit IV	<ul style="list-style-type: none"> • Articulate over the applications of risk management

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Explain stochastic processes and solve boundary problems	K1
2	Describe monte-carlo principles and derivatives pricing	K2
3	Explain random number generators	K1
4	Solve problems related to risk management	K2
5	Comprehend the pricing of American options	K3
6	Analyze the applications of risk management	K3

L	T	P	C
3	1	0	4

Course Code:

Semester: VIII

INDUSTRIAL PSYCHOLOGY

Course Objectives:

This course will help the learner to gain basic knowledge about human behavior in the workplace. The learner will learn the scientific basis of human behavior at work and how they relate to various processes of developing, managing and supporting employees in the context of Industrial and Organizational Psychology.

UNIT - I

15 Periods

Industrial-Organizational (I-O) Psychology & Individual Differences: Nature and Scope of Industrial Psychology, Importance: I-O Psychology - The Past, Present, and Future, Multi-cultural and Cross-cultural issues - Introduction to individual differences - Identifying individual differences and varieties - Human attributes: Abilities - Personality and work behaviour: Big Five and other models of personality. **Job analysis and performance:** Campbell model of job performance - Types of performance measures and Organizational Citizenship Behaviour - types of job analysis and Competency modelling

UNIT – II

15 Periods

Industrial Psychology: Foundations of assessment methods and procedures: Types of test - role of assessment centres - computer and internet-based assessments. **Performance Measurement:** uses of performance information - theories and different types of performance rating - performance rating process - performance evaluation and performance feedback - Staffing decisions: conceptual issues in staffing - evaluation of staffing outcomes and practical and legal issues in staffing decisions. Foundations of Training and Learning - methods and evaluation

UNIT – III

15 Periods

Organizational Psychology: Motivation and performance: overview of motivation theories. Attitudes - Emotion and Work - Moods - Emotions - Attitudes and Behavior - Stress and Worker Well Being: Problem of stress - Theories of Stress - Reducing and managing stress - Violence at work - Fairness and diversity at workplace - Leadership – Concept - Traditional theories of leadership - New approaches to Leadership - Current trends in Positive Psychology at workplace.

UNIT – IV

15 Periods

Teams in organization: types of teams - input-process-output model of team effectiveness - special issues in teams - team appraisal - team roles - team development and cultural issues. Organization climate and culture: Socialisation - Person-Organization fit - and overview of Organization Development and Change.

TEXTBOOK

1. Frank. J. Landy & Jeffrey M. Conte, Work in the 21st Century, *An Introduction to Industrial and Organizational Psychology*, Wiley, Fourth Edition, 2013

REFERENCES

1. Aamodt, M. G. , *Industrial/organizational psychology: An applied approach*, Cengage Learning, 2015
2. Spector, P. E., *Industrial and organizational psychology: Research and practice*, John Wiley & Sons, 2021.

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Gain basic knowledge in the context of Industrial and Organizational Psychology
Unit II	<ul style="list-style-type: none">• Understand the applicability of industrial psychology in work setting
Unit III	<ul style="list-style-type: none">• Assimilate the knowledge about organizational psychology
Unit IV	<ul style="list-style-type: none">• Comprehend team cohesiveness, team success and overall team behaviour in workplace

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Acquaint and enrich students' understanding of various terminologies related to Industrial and Organizational Psychology	K2
2	Apply psychological theories, principles, and concepts to behaviours and mental processes of employees in manpower planning decisions	K3
3	Analyse contemporary trends and emerging changes in the workplace and apply psychological perspectives for various HR functions	K4
4	Develop training programs, assessment methods and competency models to enhance Organization Citizenship Behaviour	K5
5	Design intervention programs to have conducive organization culture and climate	K6

L	T	P	C
3	1	0	4

Course Code:
Semester: VIII

ENTERPRISE SYSTEMS

Course Objectives:

This course will help the learner to get familiarize with basic elements of Enterprise Systems. Additionally, the users will be able to develop skills in understanding architecture along with the non-functional requirements in developing the enterprise system development and their deployment process. Exploring about the future trends of Enterprise Architectures can also be accomplished by the learners.

UNIT - I

15 Periods

Information Systems: Introduction to Information Systems – **Business Information Systems Functional Areas:** Electronic and Mobile Commerce – Enterprise Systems – Business Intelligence and Analytics – Knowledge Management & Specialized Information Systems. **Kinds of Information Systems:** Introduction to Electronic Commerce – Business-to-Business E-Commerce – Consumer-to-Consumer E-Commerce – Differences between models. **Sample Information Systems:** ERP, SCM, CRM, Product Life Cycle Management (PLM). **Enterprise System Architectures:** Event - Driven Batch Processing – Coordinated Batch Processing, Functions and Event – Driven Processing – Introduction and Basics.

UNIT - II

15 Periods

Enterprise Application Architectures: Layered Architecture, Event Driven Architecture, Service - Oriented Architecture, Micro Service Architecture, Plug-in Architecture. **Application Architecture Patterns:** Layering, Organizing domain logic, Mapping to database, Web Presentation, Concurrency. **Enterprise Application Integration:** Introduction to Enterprise Integration - Different Integration Style - Elements of Messaging-based Integration. **Enterprise Integration:** Emerging Standards and Futures in Enterprise Integration - Introduction to WSDL, SOAP - Introduction to RESTful Web Services Integration - Differences between SOAP and REST.

UNIT - III

15 Periods

Deployment of Enterprise Applications: Key requirements in deployment - Stability, Capacity, Security, Availability, Network, Availability, and Transparency (Basic Introduction only). **Concepts of Cloud computing, Cloud Platforms and their role in Enterprise Systems:** Core Concepts – **Types of Cloud:** Private, Public, and Hybrid clouds. **Advantage of Cloud Computing** – Scaling, Availability, and Cost. **Disadvantages** – Technology Overload, Security, Monitoring and Troubleshooting, Testing, Latency. **Cloud Service Models:** - Infrastructure, Platform, Software as a Service in Cloud Computing. **Major Public Clouds:** Google Cloud, AWS, Azure.

UNIT - IV

15 Periods

Application Development and Deployment in Cloud – Virtualization: Docker, Micro Services, Kubernetes, Serverless. Continuous Integration | Continuous Delivery. **Introduction to Enterprise Architecture:** Importance of Enterprise Architecture. **Enterprise Architecture Models** - Zachman Framework, TOGAF Framework – Case Study.

TEXT BOOKS

1. Ralph Stair, George Reynold, *Principle of Information Systems*, Cengage Learning, Thirteenth Edition, 2018.
2. Martin Fowler, *Pattern of Enterprise Application Architecture*, Addison-Wesley, First Edition, 2003.
3. Gregor Hohpe, Bobby Woolf, *Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions*, Addison – Wesley, First Edition, 2003.
4. Mark Richards, *Software Architecture Patterns: Understanding Common Architecture Patterns and When to Use Them*, O'Reilly, First Edition, 2015,.
5. Sam Newman, *Building Microservices: Designing Fine-Grained Systems*, O'Reilly, First Edition, 2015.
6. Jez Humble, David Farley, *Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation*, 2016.

REFERENCES

1. Brendan Burns, *Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Services*, O'Reilly, 2018
2. Len Bass, Paul Clements, Rick Kazman, *Software Architecture in Practice*, Addison – Wesley, Fourth Edition, 2014.

ONLINE MATERIAL

1. <https://nptel.ac.in/courses/110105148>

UNIT-WISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> • Understand the importance of information systems to be used in Enterprises along with its kinds and characteristics. • Learn the concepts of Enterprise Architectures.
Unit II	<ul style="list-style-type: none"> • Understand and learning the concepts of Enterprise Application Architectures along with application architecture patterns. • To understand the basic concepts regarding Enterprise Integration along with the basic styles and elements needed for application integration.
Unit III	<ul style="list-style-type: none"> • To inculcate knowledge about the Deployment of Enterprise Applications by considering the key requirements. • Understanding the importance of Cloud Computing concepts in the real-world along with the types, advantage, disadvantage and models.
Unit IV	<ul style="list-style-type: none"> • Learning the concepts of Application Development and Deployment in the Cloud. • Understanding the importance of Enterprise Architectures by learning about the frameworks and applying the same as Case Study.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcomes	Knowledge Level
CO1	Understand the concepts of Information Systems with its kinds and architectures	K2
CO2	Learning the concepts of Enterprise Application Architectures along with its patterns	K3
CO3	Understanding the concepts of Enterprise Application Integration that is to be implemented in the real – world scenario	K3
CO4	Examining the concepts of deployment related to enterprise applications in the real – world by understanding the key requirements needed for deployment	K3
CO5	Learning the basic concepts of Cloud Computing along with the types, advantages, disadvantages, service models, application development and deployment in the cloud environment	K3
CO6	Understanding the importance of Enterprise Architectures by learning about the frameworks and applying the same as Case Study	K4

L	T	P	C
3	1	0	4

Course Code:
Semester: VIII

ADVANCE FINANCE

Course Objectives:

This course will help the learner to understand the valuation and restructuring of the corporates and the means of managing the financial risk.

UNIT - I

15 Periods

Corporate Valuation: Overview of Corporate Valuation - Value Based Management - Corporate Governance and Shareholders' Wealth - Free Cash Flow Valuation and the Cost of Capital - Investment Decisions with NPV rule – Leasing decisions.

UNIT - II

14 Periods

Corporate Restructuring: Mergers and Acquisitions- Mechanics of mergers – Valuation under Mergers and Acquisitions - DCF approach - Financing a merger – Significance of PE Ratio and EPS analysis – Leveraged buyouts - Joint Ventures Analysis - Strategic Alliances.

UNIT – III

15 Periods

Financial Risk: Meaning and Nature - Asset Backed Risk- Credit Risk- Liquidity Risk- Operational Risk - Foreign Investment Risk & Market Risk - Financial Risk Identification based on the Balance Sheet Information – Managing financial risks.

UNIT - IV

16 Periods

Derivatives for managing financial risk: Introduction – Diversification of risk- Derivatives & Risk hedging – Hedging instruments – Options, Futures, forwards & swaps – Uses of derivatives - Interest rate - Payoff Diagrams, Pricing of Futures, Put Call Parity, Option Pricing using Binomial Model and Black Scholes Model.

TEXTBOOKS

1. Richard A. Brealey , Stewart C. Myers, Franklin Allen and Pitabas Mohanty, *Principles of Corporate Finance*, McGraw Hill Education, India, Twelfth Edition, 2018
2. Aswath Damodaran, *Corporate Finance: Theory and Practice*, John Wiley & Sons Ltd., India, Second Edition, 2003
3. Berk Jonathan and Peter DeMarzo, *Corporate Finance*, Pearson Education Ltd., India, Fifth Edition, 2019
4. Prasanna Chandra, *Financial Management, Theory and Practice*, McGraw Hill Education, Chennai, Tenth Edition, 2019

REFERENCES

1. Pierre Vernimmen, Pascal Quiry, Yann Le Fur, Maurizio Dallochio and Ntonio Salvi, *Corporate Finance: Theory and Practice*, John Wiley & Sons Ltd., India, Second Edition, 2005
2. Ross, Westerfield, Jaffe and Kakan, *Corporate Finance*, McGraw Hill. India, Tenth Edition, 2013

3. Michelle R. Clayman, Martin S. Fridson, George H. Troughton and Matthew Scanlan, *Corporate Finance: A Practical Approach*, John Wiley & Sons Ltd., India, Second Edition, 2012

UNITWISE LEARNING OUTCOMES

Upon successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none"> Understand the concept of corporate valuation and the Free Cash Flow Valuation Understand the concept of cost of capital and investment decisions.
Unit II	<ul style="list-style-type: none"> Know about the corporate restructuring and valuation under Mergers and acquisitions. Know about the various modes of financing mergers
Unit III	<ul style="list-style-type: none"> Understand the meaning of financial risks and the types Understand the means of managing financial risk.
Unit IV	<ul style="list-style-type: none"> Know the mechanism of diversification of risk Know the method of managing financial risk through hedging.

COURSE LEARNING OUTCOMES

Upon successful completion of this course, the learner will be able to:

CO No.	Course Outcome	Knowledge Level
1	Evaluate various investment decisions by measuring the free cash flow	K5
2	Understand the mechanism of mergers and acquisitions and analyse various modes of financing mergers	K4
3	Evaluate various means of managing financial risk	K5
4	Analyse the mechanism of diversification of risk	K4
5	Evaluate the means of managing the risk through hedging	K5

Course Code: INT434
Semester: VII

L	T	P	C
3	1	0	4

ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS

Course Objectives

This course will help the learner to use the tools for text mining and carry out pattern discovery, predictive modelling. Explore the use of social network analysis to understand the growing connectivity and complexity in the world around us on different scales—ranging from small groups to the World Wide Web. It also help the learners to perform social network analysis to identify important social actors, subgroups (i.e., clusters), and network properties in social media sites.

UNIT - I

15 periods

Text Mining: Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications. **Case Study:** Language Analysis

UNIT - II

15 periods

Methods & Approaches: Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction. **Case Study:** Sentiment Analysis

UNIT - III

15 periods

Web Analytics: Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models. **Case Study:** Web Analytics

UNIT - IV

15 periods

Social Media Analytics: Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis. **Case Study:** Social Media Analytics

TEXT BOOKS

1. Ronen Feldman and James Sanger. *The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data*, Cambridge University Press, First Edition, 2009.
2. Derek Hansen, Ben Shneiderman and Marc Smith. *Analyzing Social Media Networks with NodeXL: Insights from a Connected World*, Morgan Kaufmann, First Edition, 2011.
3. Avinash Kaushik. *Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity*, Sybex, First Edition, 2009.
4. Hanneman, Robert and Mark Riddle. *Introduction to Social Network Method*, LibreTexts; First Edition, 2005.

REFERENCES

1. Wasserman, S. and Faust, K. *Social network analysis: Methods and applications*, Cambridge University Press, First Edition, 1994.
2. Monge, P. R. and Contractor, N. S. *Theories of communication networks*. Oxford University Press, First Edition, 2003.

UNITWISE LEARNING OUTCOMES

After successful completion of each unit, the learner will be able to

Unit I	<ul style="list-style-type: none">• Explain the text mining operations and its applications• Interpret the contribution of text mining to generate new knowledge from natural language text
Unit II	<ul style="list-style-type: none">• Extract useful information from the textual data using various classifiers and predictors
Unit III	<ul style="list-style-type: none">• Identify the components of a web that can be used for mining process• Analyse social media data using appropriate web mining techniques
Unit IV	<ul style="list-style-type: none">• Create data visualisations and identify features of social networks• Discover interesting patterns from Social Media Networks using linear methods and models

COURSE LEARNING OUTCOMES

After successful completion of the course, the learner will be able to

CO No.	Course Outcomes	Knowledge Level
CO1	Apply the preprocessing techniques on the given data and extract useful information from the textual data using different classifiers and predictors	K3
CO2	Retrieve information from multiple social media platforms and perform sentiment analysis	K3
CO3	Analyse social media data using appropriate web mining techniques	K3
CO4	Create data visualisations and identify features of social networks	K4
CO5	Discover interesting patterns from social media networks using linear methods and models	K4
CO6	Provide solutions to the emerging problems of social media analytics with sentiment analysis and opinion mining	K4