SHSB1101	TECHNICAL ENGLISH	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand specialized subject areas and skills included for their study.
- To comprehend and react in oral and written forms to the specialized texts.
- To respond to listening, reading and writing tasks by using digital tools.
- To enhance communication, collaboration and critical thinking skills.
- To explore creativity through blended learning contexts.

UNIT 1 **9 Hrs.**

Listening : Listening to choose the correct answer from the options given (MCQ)
Speaking : Self Introduction, talking about likes and dislikes
Reading : Comprehending a passage- Skimming, scanning, detailed reading
Writing : Letter of Job Application, Resume, Letter to the Editor (problems and solutions)
Vocabulary : Kinds of Sentences, Affixes**,** Collocations, Sequence words, contextual guessing of words
Language Focus : Parts of Speech, Tense and its types, Voice - Impersonal Passive
Language Lab work : Focus Digital literacy: students join zoom platform/ using online tools

UNIT 2 **9 Hrs.**

Listening : Listening to advertisements about a product, say true or false
Speaking : JAM on current topics, mini presentations
Reading : Identifying topic sentences by reading content
Writing : Writing compare/ contrast paragraphs, process description, E-Mail Writing
Vocabulary : Verbal phrases, Prepositions and Prepositional phrases, Concord, Discourse Markers
Language Focus : Clauses, Conjunctions, Sentence Types - Simple, Compound & Complex
Language Lab : Digital literacy: Responding to quiz using Kahoot application

UNIT 3 **9 Hrs.**

Listening : Listening to summarize the information, debates/ discussions.
Speaking : Group discussion on a given topic
Reading : To find specific information and to prepare notes using the format
Writing : Framing open ended questions- Survey Report- Arranging the sentences in the right order
Vocabulary : Paired expressions, Adjectives/ adverbs, technical definitions, Compound Nouns
Language Focus : Punctuation, Editing, Same words used as different parts of speech
Language Lab : Digital literacy: Power point tools –Slide share to make presentation on the survey report

UNIT 4 **9 Hrs.**

Listening : Listening to differentiate instructions and recommendations
Speaking : Debate on current issues
Reading : Reading to understand and classify the information
Writing : Instructions, Recommendations, Preparation of User Manual

Vocabulary	**:**	Classification of words, Abbreviations, Acronyms,
Language Focus	**:**	Reported Speech, Causatives, Basic Sentence Patterns
Language Lab	**:**	Digital literacy: Using online discussion forum

UNIT 5 **9 Hrs.**

Listening and	**:**	Listening to identify the structure of sentences, small talks, summarizing TED talks
Speaking	**:**	Giving impromptu talks, Speech Writing
Reading	**:**	Read argumentative essays and paragraphs
Writing	**:**	Essay writing, Checklist preparation, Note making
Vocabulary	**:**	Homophones/Homonyms, Idioms and Phrases
Language Focus	**:**	Negatives, Tag questions, Similes and Metaphors
Language Lab	**:**	Digital literacy: Creating own Blogs and interactive exercises and quizzes online

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Classify technical words to use them in sentences framing, compose problem solving paragraphs.
CO2 - Categorize information based on the understanding of reading materials to prepare notes.
CO3 - Prepare and document to report, identify elements of editing.
CO4 - Interpret technical definitions related to the text and design a user manual using instructions.
CO5 - Summarize reading materials and outline an essay on any topic given.
CO6 - Demonstrate their language learning activities in the classroom/ online group environment.

TEXT / REFERENCE BOOKS

1. Technical English [2019], Department of English, Sathyabama Institute of Science & Technology.
2. Beer, David F., and David McMurrey. A Guide to Writing as an Engineer. 4th ed., Wiley, 2013
3. Alred, Gerald J., et al. Handbook of Technical Writing. 11th ed., Bedford/St. Martin's, 2019.
4. Pearsall, Thomas Edward. Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals. McGraw-Hill Education, 2017.
5. Straus, Jane. The Blue Book of Grammar and Punctuation. John Wiley & Sons, 2014.
6. O'Conner, Patricia T. Woe is I: The Grammar phobe's Guide to Better English in Plain English. Riverhead Books, 2019.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SMTB1103	CALCULUS AND NUMERICAL METHODS (Only for CSE specialization)	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- To identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- To model the Engineering problems and obtain its solutions mathematically.
- To understand Science, Engineering and Computer Science analytically and improve logical thinking ability.

UNIT 1 DIFFERENTIAL CALCULUS 9 Hrs.

Definitions – Derivative of standard functions (Results only) - Differentiation of function of function – Logarithmic differentiation – Derivatives of implicit function – Partial derivatives (Simple Problems only).

UNIT 2 INTEGRAL CALCULUS 9 Hrs.

Integral of standard functions (Results only) – Integration by the method of substitution– Integration using partial fractions – Integration by parts – Generalization of integration by parts – Definite integral – Properties – Simple problems.

UNIT 3 DIFFERENTIAL EQUATIONS 9 Hrs.

Higher order linear differential equations with constant coefficients – Particular Integral for e^{ax}, sinax or cosax, x^n, $x^n e^{ax}$ – Method of Variation of Parameters – Homogeneous equation of Euler's – System of simultaneous linear differential equations with constant coefficients.

UNIT 4 NUMERICAL METHODS FOR SOLVING EQUATIONS 9 Hrs.

Solution of algebraic equation and transcendental equation: Regula Falsi Method, Newton Raphson Method – Solution of simultaneous linear algebraic equations: Gauss Elimination Method, Gauss Jacobi & Gauss Seidel Method.

UNIT 5 NUMERICAL INTERPOLATION, DIFFERENTATION AND INTEGRATION 9 Hrs.

Interpolation-Newton forward and backward interpolation formula, Lagrange's formula for unequal intervals – Numerical differentiation: Newton's forward and backward differences to compute first and second derivatives – Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Evaluate Definite Integrals and analyze properties of Beta and Gamma functions
CO2 - Examine the maxima and minima of functions of several variables.
CO3 - Solve any higher order linear differential equations.
CO4 - Categorize and implement the numerical solutions of algebraic, transcendental, simultaneous linear equations.
CO5 - Appraise various numerical methods for Interpolation.
CO6 - Develop the solutions for Numerical differentiation and integration.

TEXT / REFERENCE BOOKS

1. Narayanan, S. and Manickavachagam Pillai, T.K., Calculus, Vol.I and Vol. II, S.Viswanathan Printers & Publishers, 2009.
2. P.R.Vittal., Calculus -Margham Publications, 2000
3. Veerarajan T., Engineering Mathematics for First Year, II Edition, Tata McGraw Hill Publishers, New Delhi, 2008.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.
5. Grewal B.S., Higher Engineering Mathematics, 41th Edition, Khanna Publications, New Delhi 2011.
6. Steven C. Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Publishing Co., New Delhi, 2003.
7. Kandasamy P., Thilagavathy K., and Gunavathy K., Applied Numerical Methods, S. Chand & Co., New Delhi, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SPHB1101	PHYSICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the concept of crystal structures and symmetry, the physics of scattering and diffraction theory, experimental diffraction from single crystals, instrumentation and powder diffraction.
- To understand and describe properties of matter, including: flexibility, strength and transparency.
- To develop a working knowledge of the laws and methods of thermodynamics and elementary statistical mechanics and to use this knowledge to explore various applications.
- Differentiate between various acoustic terms and understand how these apply to different materials and acoustic design solutions.
- To give knowledge about semiconductor physics and discus working and applications of basic devices, including p-n junctions, BJTs and FETs.

UNIT 1 QUANTUM MECHANICS 9 Hrs.

Introduction to Quantum Mechanics-Energy distribution function, Wave – particle duality-de Broglie matter waves – Concept of wave function and its physical significance – Heisenberg's Uncertainty Principle – Schrodinger's wave equation – Time independent and Time dependent equations – Particle in a one-dimensional rigid box – tunnelling (Qualitative) – Scanning Tunnelling Microscope (STM).

UNIT 2 PROPERTIES OF MATTER 9 Hrs.

Introduction- Elasticity- Hooke's law - Torsional stress & deformations – Twisting couple – Torsion pendulum - theory and experiment–bending of beams - bending moment–cantilever: -Theory and experiment–uniform and non-uniform bending: theory and experiment- Magnetism - Basic definitions - Magnetic permeability, susceptibility, relation between permeability and susceptibility - Bohr magneton. Classification of magnetic materials-Hysteresis.

UNIT 3 CRYSTAL PHYSICS 9 Hrs.

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances – coordination number and packing factor for SC, BCC, FCC, HCP. – crystal imperfections: point defects, line defects –growth of single crystals: solution and melt growth techniques.

UNIT 5 SEMICONDUCTOR PHYSICS 9 Hrs.

Classification of materials-Theory of semiconductors: Intrinsic and extrinsic semiconductors, band structure of semiconductors - Fermi level in intrinsic and extrinsic semiconductors. Theory of p-n junctions – diode and transistor: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, V-I characteristics, junction capacitance and voltage breakdown. Zener diode and its characterization- Avalanche breakdown- JEFT- I-V characteristics- amplifying and switching.

UNIT 5 LASER AND ITS APPLICATIONS 9 Hrs.

Absorption and Emission of Radiation by atoms, ions and molecules. Laser medium Phenomenon of population inversion. Laser cavity (fiber laser, and other cavities), generation of coherent beam, Q-switching, short pulse generation, power amplification. Basic Laser Principles: Theory of Laser, Properties of Laser, Fundamental Optical properties, Modified Optical properties, Laser output – its characteristics.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Solve the time independent Schrodinger wave equation for a particle in a box to obtain the Eigen values and Eigen functions.

CO2 - Understand the dual nature of radiation and matter

CO3 - Estimate the atomic packing factor for SC, BCC & FCC structures.

CO4 - Recognize sound level descriptors and how they are used in architectural acousticsand analyse acoustic properties of typically used materials for design consideration.

CO5 - Understanding the working, design considerations and applications of various semi conducting devices including p-n junctions, BJTs and FETs.

CO6 - Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.

TEXT / REFERENCE BOOKS

1. Pillai S.O., Solid state Physics, New age International Publishers, 7th Edition.
2. Arthur Beiser, Concepts of Modern Physics, Tata McGraw Hill Publications.
3. M.N.Avadhanulu&P.G.Kshirasagar. A text book of Engineering Physics, S. Ch.Publishing.
4. B. B.Laud,Lasers and nonlinear optics, New age International Publishers, II-Edition.
5. R. Murugesan, Modern Physics, S. Chand Publishing, 15th Edition (2015).
6. D. S. Mathur, Elements of Properties of Matter, S. Chand Publishing (2014).
7. A. K. Bandyopadhyay, Nanomaterials, New age International Publishers,
8. K. K. Chattopadhyay, Introduction to nano science and nano technology, PHI publisher,
9. Sulabha Kulkarni, Introduction to Nanoscience and Nanotechnology 2nd Edition
10. David Griffiths, Introduction to electrodynamics, Addison-Wesley publishing 3rd Edition.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SEEB1101	ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the fundamental concepts of electrical wiring and its components
- To analyze DC and AC circuit behavior
- To impart Knowledge on electronic devices and their applications.
- To gain Knowledge on operation of UPS and SMPS power supplies.

UNIT 1 INTRODUCTION TO ELECTRICAL SYSTEMS 9 Hrs.

Basic Element Resistors, inductors and capacitors - Domestic Wiring - Wiring Materials and Accessories -Staircase Wiring - Fluorescent Tubes-Earthing-Types & Benefits.

UNIT 2 DC CIRCUITS 9 Hrs.

Electrical Quantities - Ohm's law - Kirchoff's laws -Resistance in series and parallel combinations - Current and Voltage division rules - Mesh analysis and Nodal analysis.

UNIT 3 AC CIRCUITS 9 Hrs.

Sinusoidal functions - R.M.S and Average values for Sinusoidal waveform - Phasor representation - Sinusoidal excitation applied to purely resistive, inductive and capacitive circuits - RL , RC and RLC series circuits - power and power factor.

UNIT 4 SEMICONDUCTOR DEVICES 9 Hrs.

VI Characteristics of PN-junction diodes and Zener diodes, BJT and its configurations – input/output Characteristics, Junction Field Effect Transistor – Drain and Transfer Characteristics - Silicon Controlled Rectifiers.

UNIT 5 POWER SUPPLY 9 Hrs.

Introduction to Power Supplies- Regulated power supplies- Single and Dual regulated power supply- Design using regulator IC- Switched Mode Power Supply (SMPS) - Design used in Computer Systems- Introduction to Uninterrupted power supplies (UPS), online UPS, offline UPS, high frequency online UPS.

Max.45 Hrs.

COURSEOUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental electrical concepts.
CO2 - Analyze simple DC circuits using appropriate techniques
CO3 - Apply phasor analysis techniques to solve AC circuits.
CO4 - Demonstrate the characteristics of various semi-conductor devices
CO5 - Analyze characteristics of Switched Mode Power Supply
CO6 - Design power supply unit using regulator IC.

TEXT / REFERENCE BOOKS

1. Dr. Ramana Pilla, Dr. M Surya Kalavathi & Dr. G T Chandra Sekhar, Basic Electrical Engineering, S.Chand & Co.,2022.
2. Dr.Sanjay Sharma ,Electronic Devices and Circuits,2nd edition,S.K.Kataria & Sons,2012.
3. B.N.Mittle & Aravind Mittle, Basic Electrical Engineering,2nd edition,Tata McGraw Hill,2011.
4. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering,2nd edition,PHI Learning PrivateLtd,2010.

5. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics,1st edition,S.Chand & Co.,2009.
6. G.K.Mithal, Basic Electronic Devices and circuits,2nd Edition,G.K.Publishers Pvt,2008

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S11BLH11	PROGRAMMING IN C	L	T	P	EL	Credits	Total Marks
		2	0	4	0	4	100

COURSE OBJECTIVES

- To understand the concepts of variables, operators, control structures and arrays.
- To gain knowledge on Functions, Structures and Union in C.
- To explore the concepts of pointers and files to create real world applications using C.

UNIT 1 BITS AND BYTES IN COMPUTING 12 Hrs.

Computers: Hardware – Software – Processor – Memory – I/O devices – Interface – Programming Languages – Evolution from COBOL, FORTRAN to C, Python – Need

Algorithms: Role in problem solving – Analysis – Design – Flowcharts: Role in problem solving – Symbols – Design – Pseudo code: Role in problem solving – Design – Program: Role in problem solving – Design.

Practical:

- Describe a simple real-world problem in your domain of interest and describe it in the form of problem statement, input, output and provide its solution in terms of algorithm, flowchart, pseudo code and program.

UNIT 2 C: MATH BEHIND CODING 12 Hrs.

C: Structure of program – Character set – Tokens – Keywords – Identifiers – Constants – Variables – Data types – Strings – Operators and its types – Functions – Header Files

Algorithmic Strategies: Iteration and Recursion – Efficiency – Role of Time and Space consumption while building an algorithm – Complexities.

Practical:

- Describe a simple real-world problem in your domain of interest and provide a computing and non-computing solution for the same. Calculate the time and space consumed in both solutions. Compare and contrast the pros and cons in both solutions.
- Write an algorithm, flowchart, pseudo code followed by a simple C code to do find the Factorial and Fibonacci series using both iteration and recursion.
- Get the number of days taken to cultivate both rice and wheat in turns in an agricultural land from the user. Write a C program to convert the days and display as years, months and days using simple operators.
- You have a circular plot for building playground and a rectangular plot for building an apartment. Get the input from the user for both plots and write a C program to calculate the area and perimeter of both plots.

UNIT 3 C: MAGIC BEHIND INSTANT OUTPUTS 12 Hrs.

Advanced Coding Concepts: Decision Making using Branching Statements and its types – Decision Making using Looping Statements and its types – Switch Statements – Break – Continue – Goto – Jump Statements.

Case Study: Fun with Code -- Printing Alphabets / Flags of Countries / Flying Alphabet Screensaver

Practical:

- Describe a problem statement in your domain of interest whose solution involves repetition of same steps and provide code as solution involving for, while and do while loops.
- Describe a problem statement in your domain of interest whose solution involves decision making and provide code as solution involving if-else, nested if-else and ladder if-else.
- Develop a simple scientific calculator using Switch case statement.
- A Cartesian co-ordinate system has four quadrants. Write a C program to find the quadrant of the co-ordinate points given by the user using both if-else and nested if-else control structure.

- Given a rose flower to you, dismantle the petals of the flower from inside, if you notice - it follows the sequence of Fibonacci. Now, try to arrange the word "PIZZA" in several ways without repeating and calculate number of ways it can be done using factorial concept. Write a C program to find both Fibonacci and factorial by getting the mentioned input.
- Product of two large prime numbers is used as encryption key in encryption algorithms. Write a C program to display all the prime numbers between 1 to 100 and give the first two largest numbers as the output.

UNIT 4 STORING GROUP OF HOMOGENOUS ELEMENTS: ARRAYS 12 Hrs.

Diving into Arrays: Definition – Syntax – Types – Representation: Row and Colum Order – Dynamic Arrays.

Idea behind Functions: Declaration – Definition – Types – Calling – Arguments – Prototypes –

Call by Value – Call by Reference – Pointers – Amalgamation of Pointers: with Arrays and Strings

Case Study: Fun with Code – Simple Game Development using Arrays and Functions.

Practical:

- Describe a problem statement in your domain of interest where you need to work with group of same type of data. Provide a solution in terms of C program to store and manage the data effectively.
- You're playing UNO cards, suddenly a person is getting rev card. Write a C program to reverse the round by storing the number of players in array.
- Write a C program for Vehicle Regulation System where odd number ending vehicles can use the road on odd days and even number ending vehicles can use the road on even days using two separate arrays to store and display the odd and even numbers.
- Write a C program to do the following applications in array:
  (i). Get set of +ve and -ve integers from user, replace -ve integers by 0 in the array.
  (ii). Reverse the floating point numbers stored in the array.
  (iii). Return the smallest value and largest value position in the array.
  (iv). Search the number '5' in array and replace it with '10'
- Write C program to do the following string handling applications.
  (i). Get favourite actor and actress name, concatenate it and display
  (ii) Display your name in uppercase, lowercase and as fname and lname.
  (iii). Count the frequency of "the" in any sentence and delete it from sentence.
  (iv). Check whether the given string is a palindrome or not.
- Write C program to do the following string handling applications.
  (i). Get favourite actor and actress name, concatenate it and display
  (ii). Display your name in uppercase, lowercase and as fname and lname.
  (iii). Count the frequency of "the" in any sentence and delete it from sentence.
  (iv). Check whether the given string is a palindrome or not.
- Write a C program for counting the total number of duplicate elements in an array, print all the unique elements in the same array as two different functions.
- Write a C program to sort the elements in an array in both ascending and descending order using two different functions.
- Write a C program to find the largest and smallest number in an array using recursion and to convert the output into a binary number.
- Write a C program to swap two numbers using two functions, one using pointers and the other one without using pointers.

UNIT 5 STORING GROUP OF HETROGENOUS ELEMENTS: STRUCTURE 12 Hrs.

Outset of Structure and Union: Structure Definition & Declaration – Structures Fusion with: Arrays –

Pointers – Functions – Union Initiation, Definition & Declaration – Memory Allocation: Static and Dynamic Working with Files: File Handling Functions – Read – Write – Other Operations – Different File Types. Case Study: Report on using File Functions to create Score Board for any game, importing it to program

Practical:

- Describe a problem statement in your domain of interest where you need to work with group of different type of data. Provide a solution in terms of C program to store and manage the data effectively.
- Write a C program to get the details of the student (roll no, name, date of birth, state, 10th percentage and 12th percentage) using Structure. Calculate the age of the student and display the eligibility status for his admission.
  i.Eligibility criteria: more than 60 percent in 10th and 12th, age>=17, state==TN.
- Write a menu driven C program for library management system with ten entries:
  (i). Add Book (ii). Add Author (iii). Add Category (iv). Book Cost
  (v). Display - Book by Author, Book by Category, Book under cost
- Write a C program to create an employee Union with employee details (id, name, salary) Accept the details of 'n' employees, rearrange the data in ascending order of employee name, id and salary as three different functions and display it.

Complex Practice Problems:

- Design a C program by creating your own header file for any function of your choice and display the output by calling the header file.
- Create TIC-TAC-TOE game using C Language.
- Given a situation, you are going to ATM to withdraw money. Write a C program, get the money requested from the user as input and display the number of possible bank notes for the requested money. Note: Give input as number ending in 0's or 5's.
- Develop a C program for managing Car Rental process with various modules for registration as new user, login, get id proof, keep track of cars available and cars given for rental.
- Create SUDOKU game using C Language.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Interpret the difference between components of problem solving such as algorithm, flowchart, pseudo code and source code.

CO2 - Build simple solution for any given problem statement using various components of problem-Solving techniques and measure its efficiency in terms of time and space.

CO3 - Infer and examine the roots and foundation of C programming's key concepts like Datatypes, Operators.

CO4 - Devise and correlate the use of different core concepts such as Arrays and Functions in C language.

CO5 - Formulate real time solutions through programs using Structure and Union in C language.

CO6 - Design and Develop various Application Oriented Program for solving real time societal problems.

TEXT / REFERENCE BOOKS

1. Yashavant Kanetkar, "Let us C", BPB Publications, Fourteenth Edition
2. R.G.Dromey "How to solve it by computer", Pearson Education, Low Price Edition.
3. Balagurusamy, "Programming in ANSI C", McGrawHill Publications, Eighth Edition.
4. Greg Perry, Dean Miller "C Programming Absolute Beginner's Guide", Third Edition.

SPHB2101	PHYSICS LAB	L	T	P	EL	Credits	Total Marks
		0	0	2	0	1	50

SUGGESTED LIST OF EXPERIMENTS

1. To determine the Rigidity modulus of a given wire by Torsional pendulum
2. To determine the angle of Minimum Deviation by I - D curve method.
3. Determine V-I characteristics of a photodiode
4. To determine the Numerical aperture of an optical fiber
5. To find the Energy gap of a semiconductor
6. Determination of Young's modulus- non-uniform bending
7. Determination of Young's modulus- Uniform bending
8. Determination of the wave length of the laser using grating- Laser.
9. Determination of thickness of a thin sheet/wire- Air wedge.
10. Determination of Numerical Aperture and acceptance angle- Optical fiber.
11. Photoelectric effect
12. Michelson Interferometer.
13. V-I characterization of solar cell
14. CRO- FUNCTIONS

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Measure the rigidity modulus of a given wire by oscillations.

CO2 - Measure the angle of minimum deviation by spectrometer.

CO3 - Analyze the I-V characteristics of the given photo diode.

CO4 - Measure the band gap of the given semiconductor.

CO5 - Measure the young's modulus of bar by uniform bending method.

CO6 - Determine the wavelength of the given laser light source.

SMTB1203	DISCRETE STRUCTURES (ONLY FOR CSE SPECIALIZATION)	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- To identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- To model the Engineering problems and obtain its solutions mathematically.
- To understand Science, Engineering and Computer Science analytically and attain logical thinking.

UNIT 1 LOGIC 9 Hrs.

Statements – Truth Tables – Connectives – Equivalent Propositions – Tautological Implication – Normal Forms – Inference Theory – Consistency and Inconsistency of Premises. Proportional Functions – Quantifiers – Universal and Existential – Inference Theory – Rules of Inference Theory – Problems.

UNIT 2 ALGEBRAIC STRUCTURES 9 Hrs.

Algebraic system – Semigroups – Monoids (definitions and examples only) – Groups – Cyclic groups – Subgroups – Cosets – Lagrange's Theorem.

UNIT 3 COMBINATORICS 9 Hrs.

Mathematical Induction – Recurrence Relation – Solving Homogeneous and Non- Homogeneous Recurrence Relations – Generating Functions-Partial order relation – Hasse Diagram – Lattices – Properties of Lattices – Duality of Lattices – Special Lattices – Modular lattices – Complemented Lattices – Distributive Lattices.

UNIT 4 BOOLEAN ALGEBRA 9 Hrs.

Boolean Identities – Atomic Boolean Algebra – Boolean Functions – Simplification of Boolean Functions.

UNIT 5 GRAPH THEORY 9 Hrs.

Introduction to Graphs – Graph Terminology – Cycles – Paths – Complete and Bipartite Graphs – Matrix Representation of Graphs – Graph Isomorphism – Connectivity – Trees – Euler and Hamiltonian Graphs.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to:

CO1 - Apply logic and truth tables to solve problems on Inference theory for propositional calculus and predicate calculus. Distinguish PCNF and PDNF.

CO2 - Understand the basics of group properties and cosets. Apply the above concepts to derive Lagrange's theorem.

CO3 - Appraise the solution of mathematical induction and pigeonhole principle. Develop the recurrence relation and Generating functions.

CO4 - Analyze properties of functions and groups.

CO5 - Develop Euler, Hamiltonian paths. Identify graph isomorphism.

CO6 - Illustrate the generality of tree, binary tree and tree expression.

TEXT / REFERENCE BOOKS

1. Kenneth H. Rosen, Discrete Mathematics and its applications, 6thEdition, McGraw- Hill, 2007.
2. Veerarajan T, Discrete mathematics with Graph Theory and Combinatorics, Tata Mcgraw Hill

Publishing Co., NewDelhi, 2006.
3. Narasingh Deo, Graph Theory with application to Engineering and Computer Science, Prentice Hall India, 2010.
4. Steven C .Chapra, Raymond P. Canale, Numerical Methods for Engineers, Tata McGraw Hill Publishing Co., NewDelhi, 2003.
5. Kandasamy P., Thilagavathy K., and Gunavathy K., Applied Numerical Methods, S.Chand & Co., New Delhi, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCYB1101	CHEMISTRY (Common to ALL BRANCHES OF ENGINEERING)	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the basic concepts of quantum chemistry from bonds to bands.
- To learn the principles and applications of energy levels in molecules.
- To know the importance of electrochemistry in batteries.
- To explore the concept of corrosion mechanism and design principles.
- To study the various synthetic approaches in nano chemistry.

UNIT 1 ATOMIC AND MOLECULAR STRUCTURE 9 Hrs.

Introduction to quantum chemistry – Motion of a quantum mechanical particle in one dimension (time-independent) – Physical meaning of wave function – Schrodinger equation for Hydrogen atom (No derivation. Only wave function). Angular and radial wave functions and probability densities – Quantum numbers – Principal, azimuthal, spin and magnetic quantum numbers – Wave functions and orbital shapes - s,p,d,f - LCAO-MO of H_2 – Band theory of solids: Conductors, semi-conductors– Role of As and Ga doping on band structures.

UNIT 2 MOLECULAR SPECTROSCOPY 9 Hrs.

Electromagnetic spectrum – Interaction of radiation with matter – Energy levels in molecules – Microwave spectroscopy – Principle – Classification of molecules based on moment of Inertia – Rotational energy expression (J levels) – Calculation of J for CO molecule – Vibrational spectroscopy – Normal modes of vibrations – Vibrations of polyatomic molecules (CO_2 and H_2O) – Determination of Force constant – Electronic transitions in organic molecules – Mathematical derivation of Beer-Lambert's law.

UNIT 3 ELECTROCHEMISTRY 9 Hrs.

Electrochemistry: Galvanic cell - Electrochemical cell representation - EMF series and its significance. Batteries: Terminology – Mechanism of Lead-acid accumulator - Mechanism of Nickel-cadmium batteries. Mechanism of Lithium batteries: Li/$SOCl_2$ cell - Li/I_2 cell - Lithium ion batteries. Mechanism of Fuel Cells: Hydrogen-oxygen fuel cells - Solid oxide fuel cell (SOFC).

UNIT 4 CORROSION SCIENCE 9 Hrs.

Introduction: Definition. Types: Dry corrosion: Mechanism - Pilling-Bedworth rule - Wet Corrosion: Mechanism. Types: Galvanic corrosion and differential aeration cell corrosion. Galvanic series and its significance. Factors influencing corrosion. Corrosion prevention: Material selection and design - Cathodic protection – Sacrificial anodic method and impressed current method – Inhibitors – Anodic and Cathodic inhibitors.

UNIT 5 CHEMISTRY OF MATERIAL SCIENCES 9 Hrs.

Phase equilibria: Gibbs phase rule – Terms involved in Phase rule – Phase diagram of water system – Thermal method of analysis – Construction of simple eutectic system (Lead-Silver alloy system).

Fuels– Classification of fuels – Determination of calorific values of solid fuels by bomb calorimeter– Manufacture of synthetic petrol by Fischer-Tropsch method – Knocking in IC engines – Chemical structure – Octane and cetane rating of fuels.

Nanomaterials: Size dependent properties of nanomaterials – Synthesis of gold and silver nanoparticles by Chemical reduction method–Applications of nanoparticles in medicine.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to:

CO1 - Apply the principles of quantum chemistry for energy level quantization in molecules.

CO2 - Analyze the molecular transitions by interaction of EMR with matter

CO3 - Assess the reaction mechanism in electrochemical storage device

CO4 - Comprehend the corrosion mechanism for environmental sustainability. Examine the mechanism of corrosion for mitigation.

CO5 - Interpret the role of phase diagram/ fuels/ nanoparticles in chemical/ material science.

CO6 - Apply the concept of chemical science in real world applications.

TEXT / REFERENCE BOOKS

1. A.K.Chandra, Introductory Quantum Chemistry, Tata McGraw-Hill, 4th edition, 2019.
2. Ira N. Levine, Physical chemistry, 6th Edition, 2018.
3. Ira N. Levine, Quantum chemistry, 7th Edition, 2013.
4. David W. Ball and Thomas Baer, Physical Chemistry, Wadsworth Cengage Learning, 2nd Edition, 2014.
5. Mars G Fontana, Corrosion Engineering, 3rd Edition, Tata McGraw Hill, 2018.
6. Douglas A. Skoog and Donald M.West, Principles of Instrumental Analysis, Cengage, 6th Edition, 2014.
7. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai Publication, 2018.
8. David Linden, Thomas B Reddy, Handbook of Batteries, 4th Edition, McGraw-Hill, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1231	DATA AND INFORMATION SCIENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- Learn how to process raw data into formats necessary for analysis
- Conquer in-depth knowledge of data science concepts through motivating real-world case studies.
- Understand the methods and principles of data handling and big data.

UNIT 1 DATA ACQUISITION 9 Hrs.

Data Acquisition–Sources of acquiring the data - Internal systems and External systems- Web APIs, Data preprocessing- Exploratory Data Analysis (EDA)- Basic tools (plots, graphs and summary statistics) of EDA -Open Data Sources, Data APIs, Web Scrapping -Relational Database access (queries) to process/access data.

UNIT 2 DATA PREPROCESSING AND PREPARATION 9 Hrs.

Data Munging, Wrangling - Data Visualization Basics -Plyr packages - Cast/Melt. Tableau: Creating Visualizations in Tableau- Data hierarchies, filters, groups, sets, calculated fields-Map based visualizations-Build interactive dashboards-Data Stories.

UNIT 3 DATA QUALITY AND TRANSFORMATION 9 Hrs.

Data imputation -Data Transformation (minmax, log transform, z-score transform etc.,). - Binning, Classing and Standardization. - Outlier/Noise& Anomalies.

UNIT 4 HANDLING TEXT DATA 9 Hrs.

Bag-of-words- Regular Expressions - Sentence Splitting and Tokenization - Punctuations and Stop words, Incorrect spellings - Properties of words and Word cloud - Lemmatization and Term-Document TxD computation -Sentiment Analysis (Case Study).

UNIT 5 PRINCIPLES OF BIG DATA 9 Hrs.

Introduction to Big Data - Challenges of processing Big Data (Volume, Velocity and Variety perspective) - Use Cases.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Explore the fundamental concepts of Data science.
CO2 - Identify and execute the basic data format.
CO3 - Understand basics of Data Preprocessing and Data Visualization.
CO4 - Improve the Data quality through various transformations.
CO5 - Implement the methods of handling text data.
CO6 - Analyze and understand the basics of Big Data.

TEXT / REFERENCE BOOKS

1. Data Science at the Command Line, Jeroen Janssens, O'Reilly, 2015, ISBN 978-1-491-94785-2.
2. Python for Data Analysis, Wes McKinney, O'Reilly, 2018, ISBN-13: 978-1- 491-95766.
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly. 2014.
4. Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SECB1102	FUNDAMENTALS OF DIGITAL SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on various types of Binary logics.
- To design a binary logic circuit for an arithmetic expression.
- To understand the usage of registers and counters used in various digital circuits.
- To understand the design of memory devices used.
- To get an exposure about the electronics behind design of Basic digital logical elements.

UNIT 1 NUMBER SYSTEMS, LOGIC FUNCTIONS AND BOOLEAN ALGEBRA 9 Hrs.

Number systems – Number systems conversions - Binary arithmetic – Binary codes – Logic Functions- Universal gate functions - Boolean algebra – Functionally complete operation sets, Reduction of switching equations using Boolean algebra, Realization of switching function.

UNIT 2 DESIGN OF COMBINATIONAL LOGIC 9 Hrs.

Design procedure of Combinational Logic – Design of two-level gate networks - Sum of Products (SOP) - Product of Sums (POS) - Canonical SOP - Canonical POS - Karnaugh Map - Simplifications of Boolean functions using Karnaugh Map and implementation using Logic function – Advantages and limitations of K-Map - Tabulation method - Simplifications of Boolean functions using Tabulation method.

UNIT 3 COMBINATIONAL CIRCUITS 9 Hrs.

Introduction to Combinational circuits – Half Adder, Full Adder - Half Subtractor, Full Subtractor- Parallel binary Adder, Parallel binary Subtractor - Carry look ahead Adder- BCD Adder- Decoders- Encoders - Priority Encoder- Multiplexers- MUX as universal combinational modules- Demultiplexers- Code convertors- Magnitude Comparator.

UNIT 4 SEQUENTIAL CIRCUITS 9 Hrs.

Introduction to Sequential circuits – Flip flops – SR, JK, D and T flip flops, Master Slave flip flop, Characteristic and excitation table – Realization of one flip flop with other flip flops – Registers – Shift registers – Counters – Synchronous and Asynchronous counters – Modulus counters – Ring Counter – Johnson Counter – State diagram, State table, State minimization – Hazards.

UNIT 5 DIGITAL LOGIC FAMILIES, MEMORIES AND PROGRAMMABLE DEVICES 9 Hrs.

Classification and characteristics of logic family – Bipolar logic family – Saturated logic family – Non saturated family – Unipolar family – MOS, CMOS logic families. Classification and Organization of memories – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze various coding techniques and number conversion systems.
CO2 - Develop suitable techniques to minimize the Boolean equations.
CO3 - Design the digital circuit using combinational logic.
CO4 - Design the digital circuit using sequential logic.
CO5 - Analyze the performance of various digital logic families.
CO6 - Solve the arithmetic expressions using memories and programmable logic devices and implement memory units with Programmable logic devices

TEXT / REFERENCE BOOKS

1. John M. Yarbrough, “Digital logic: Applications and Design”, Thomas - Vikas Publishing House, 2002.
2. Morris Mano, “Digital design-With an Introduction to the Verilog HDL”, 5th Edition, Pearson, 2013.
3. R.P.Jain, “Modern Digital Electronics”, 4th Edition, TMH, 2010.
4. Thomas L Floyd, “Digital Fundamentals”, 11th edtion, Pearson, 2015
5. William H. Gothmann, “Digital Electronics”, Prentice Hall, 2001.
6. Tutorial Website: https://www.tutorialspoint.com/digital_circuits/index.htm.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S11BLH21	PROGRAMMING IN PYTHON	L	T	P	EL	Credits	Total Marks
		3	0	2	1	4	100

COURSE OBJECTIVES

- To learn about data structures lists, tuples, and dictionaries in Python.
- To build packages with Python modules for reusability and handle user/custom exceptions.
- To create real world GUI applications, establish Database connectivity and Networking.

UNIT 1 INTRODUCTION TO PYTHON 12 Hrs.

History of Python- Introduction to the IDLE interpreter (shell) - Data Types - Built-in function – Conditional statements - Iterative statements- Input/output functions - Python Database Communication - data analysis and visualization using python

Practical:

- Implement built-in functions and trace the type of data items.
- Implement concepts of Conditional and Iterative Statements.
- Use the built-in csv module to read and write from a CSV file in Python.
- Perform data analysis and visualization on a given dataset using Python libraries like pandas, numpy, matplotlib and display charts, graphs, and plots.

UNIT 2 OBJECT ORIENTED CONCEPTS 12 Hrs.

Class – Objects – Constructors – Polymorphism – Encapsulation -Inheritance -Data Abstraction-Method Overloading-Method Overriding-Database Access-Data Hiding-Import Class.

Practical:

- Execute concepts on Polymorphism, Encapsulation.
- Implement Data Abstraction and Inheritance.
- Differentiate Method Overloading and Overriding.
- Create a class called "Person" with attributes "name" and "age." Make the "age" attribute private and implement a getter method to access it.
- Create a module called "math_operations.py" with a class called "Calculator." Import the "Calculator" class into another script and use its methods to perform mathematical operations.

UNIT 3 FILES AND EXCEPTIONS HANDLING, MODULES, PACKAGES 12 Hrs.

File Operations –Iterators - Exception handling - Regular Expressions- Functions and Modules-Import Statement Introduction to PIP-Installing Packages via PIP-Using Python Packages.

Practical:

- Create a text file called "numbers.txt" and write the numbers from 1 to 10 in words, each on a separate line.
- Implement a custom iterator that generates a sequence of Fibonacci numbers and print the first 10 numbers.
- Create a try-except block to catch a File Not Found Error and print a message when a file is not found.
- Write a Python program that handles a Zero Division Error and prints a custom error message to the console.
- Create a module called "greetings.py" with a function called "hello" that prints "Hello, World!" Import the module into another script and use the "hello" function.
- Install the "numpy" package using PIP. Import the package and create a NumPy array with random values.

UNIT 4 GUI PROGRAMMING 12 Hrs.

GUI Programming in Python - Introduction to GUI library - Layout management - Events and bindings - Fonts – Colors - Canvas - Widgets (frame, label, button, check box, entry, list box, message, radio button, text, spin box).

Practical:

- Design a GUI form with a vertical box layout that includes labels and entry fields for user registration information.
- Create a GUI window with a grid layout that contains buttons representing a 3x3 game board.
- Create a canvas in your GUI program and draw simple shapes such as rectangles, circles, and lines.
- Create a GUI form program that includes various widgets and implement event handling Concepts also add Create a drop-down menu that allows users to select different font styles for text display.

UNIT 5 DATABASE AND NETWORK 12 Hrs.

Database (using NoSQL): Connector Module –Cursor – Statements - Exceptions in database. Network connectivity: Socket module - Client – Server –Email – URL Access.

Practical:

- Connect to the NoSQL database using a Python connector module, such as "pymongo" for MongoDB or "cassandra-driver" for Cassandra.
- Use a cursor to iterate over the records in a collection/table and print specific fields/attributes.
- Implement error handling for specific scenarios, such as duplicate key violation or record not found, in the NoSQL database.
- Implement either a TCP/IP or UDP client-server application using the socket module for sending and receiving messages.
- Write a program using the smtplib module to send an email from a specified email address to another recipient.

Max. 60 Hrs.

COURSE OUTCOMES

On Completion of the course the student will able to:

CO1 - Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
CO2 - Do the decision making and write functions in Python.
CO3 - Explain how to design GUI Applications in Python and evaluate different database operations.
CO4 - Design and develop Client Server network applications using Python.
CO5 - Ability to design real life situational problems and think creatively about solutions of them.
CO6 - Apply the best features of mathematics, engineering and natural sciences to program real life problems.

TEXT / REFERENCE BOOKS

1. Y. Daniel Liang, “Introduction to Programming Using Python”, Pearson, 2013.
2. Python Notes for Professionals by Stack Overflow Documentation (https://books.goalkicker.com/PythonBook/)
3. Dr. Charles R. Severance, “Python for Everybody- Exploring Data Using Python 3”, 2016.
4. Paul Gries, Jennifer Campbell, Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Pragmatic Bookshelf, 2nd Edition, 2014.

S731BLH22	DATA STRUCTURES AND ALGORITHMS	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVES

- To impart the basic concepts of data structures and algorithms.
- To be familiar with writing recursive methods
- To implement operations on Linked List, Stack and Queues.
- To implement traversal operations of trees and graphs.
- To understand concepts about various algorithm design techniques, searching and sorting techniques.

UNIT 1 INTRODUCTION TO ALGORITHMS 12 Hrs.

Introduction to Data vs Information - Data Structures - Classification – Abstraction - Abstract data types (ADT) - Array - characteristics - Storage Representations. Array Order Reversal- Recursion- Array operations, Algorithm- complexity – Time and Space trade off.

Practical:

- Python program to find the sum of all elements of an array
- Python program to find a series in an array consisting of characters
- Python program to find the occurrence of a particular number in an array
- Python program to find the largest element in an array
- Python program for array rotation

UNIT 2 LINKED LIST 12 Hrs.

Array Vs Linked List – Singly linked list - Representation of a linked list in memory - Operations on a singly linked list - Merging two singly linked lists into one list - Reversing a singly linked list – Polynomial Manipulation using List - Advantages and disadvantages of singly linked list - Circular linked list - Doubly linked list - Circular Doubly Linked List.

Practical:

- Program to implement operations on a Singly linked list.
- Program to implement operations on a doubly linked list

UNIT 3 STACKS AND QUEUES 12 Hrs.

Introduction – Array Representation of a Stack – Linked List Representation of a Stack - Stack Operations - Algorithm for Stack Operations - Stack Applications: Tower of Hanoi - Infix to postfix Transformation - Evaluating Arithmetic Expressions. Queue – Introduction – Array Representation of Queue – Linked List Representation of Queue - Queue Operations - Algorithm for Queue Operations -. Queue Applications: Priority Queue.

Practical:

- Program to implement a Stack using an array and Linked list.
- Program to implement Queue using an array and Linked list.
- Program to implement Circular Queue.

UNIT 4 TREES AND GRAPHS 12 Hrs.

Preliminaries of Tree ADT - Binary Trees - The Search Tree ADT–Binary Search Trees - AVL Trees - Tree Traversals - B-Trees - Heap Tree – Preliminaries of Graph ADT - Representation of Graph – Graph Traversal - BFS – DFS – Applications of Graph – Shortest - Path Algorithms – Dijkstra's Algorithm Minimum Spanning Tree – Prims Algorithm.

Practical:

- Program to convert an infix expression to postfix expression.

- Program to implement BFS and DFS
- Program to implement N Queens problem.
- Program to implement Binary Tree Traversal
- Program to implement Travelling Salesman Problem.

UNIT 5 ALGORITHM DESIGN TECHNIQUES AND SEARCHING AND SORTING TECHNIQUES 12 Hrs.

Divide and Conquer Strategy – Greedy Algorithm – Dynamic Programming – Backtracking Strategy - List Searches using Linear Search - Binary Search - Fibonacci Search - Sorting Techniques - Insertion sort - Heap sort - Bubble sort - Quick sort - Merge sort - Analysis of sorting techniques.

Practical:

- Program to sort the elements using insertion sort.
- Program to sort the elements using quick sort.
- Program to sort the elements using merge sort.
- Program to find an element using Linear and Binary Search.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to:

CO1 - Understand the concept of recursive algorithms.
CO2 - Demonstrate the different types of data structures.
CO3 - Able to understand the operations on linear data structures.
CO4 - Summarize searching and sorting techniques.
CO5 - Choose appropriate data structure as applied to specified problem definition.
CO6 - Understand and implement the various algorithm design techniques.

TEXT / REFERENCE BOOKS

1. Jean-Paul Tremblay, Paul G. Sorenson,'An Introduction to Data Structures with Application', TMH, 2017.
2. Richard F, Gilberg, Forouzan, "Data Structures", Cengage, 2004, 2nd Edition.
3. Larry R. Nyhoff, ADTs, Data Structures, and Problem Solving with C++, Prentice Hall Editin, 2004.
4. Thomas H. Cormen, Charles E. Leiserson, "Introduction to Algorithms", 3rd Edition, 2010.

SCYB2101	CHEMISTRY LAB	L	T	P	EL	Credits	Total Marks
		0	0	2	0	1	50

COURSE OBJECTIVES

- To understand the basic principle involved in volumetric and instrumental analysis.
- To acquire practical knowledge in pHmetry, potentiometry and conductometry.
- To develop the skill in water analysis.

SUGGESTED LIST OF EXPERIMENTS

1. Estimation of mixture of acids by conductometry.
2. Estimation of ferrous ion by potentiometry.
3. Determination of pKa value of glycine by pHmetry.
4. Estimation of hardness of water by EDTA method.
5. Determination of alkalinity of water
6. Estimation of Iron by photocolorimetry.
7. Estimation of copper in brass
8. Determination of high molecular weight polymer using Ostwald viscometer.

COURSE OUTCOMES

On completion of the course the student will be able to:

CO1 - Estimate the ionic conductance of mixture of acids.
CO2 - Construct a redox cell for the emf measurement.
CO3 - Interpret the concept of Zwitter ion in amino acids
CO4 - Predict the quality of water sample for domestic and industrial applications.
CO5 - Demonstrate the validity of Beer-Lambert's law.
CO6 - Apply Poiseuille's law for molar mass measurement.

TEXT / REFERENCE BOOKS

1. G,H. Jeffery, Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition. Persons Education 2004.
2. S. S. Dara, Experiments and Calculations in Engineering Chemistry, S. Chand and Co. 2010.

SMTB1304	MATRICES AND LINEAR ALGEBRA (ONLY FOR CSE SPECIALIZATION)	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- To identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- To model the Engineering problems and obtain its solutions mathematically.
- To understand Science, Engineering and Computer Science analytically and attain logical thinking.

UNIT 1 MATRICES 9 Hrs.

Characteristic equation of a square matrix – Eigen values and Eigen vectors of a real matrix – Properties of eigen values and eigen Vectors – Cayley-Hamilton theorem (without proof) – verification, finding inverse and power of a matrix – Diagonalization of a matrix using orthogonal transformation – Quadratic forms – Nature of quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT 2 VECTOR SPACES 9 Hrs.

Vector Spaces – Definition – Simple properties – Examples – Sub spaces and algebra of subspaces – Quotient spaces –Internal direct sum – External direct sum.

UNIT 3 LINEAR INDEPENDENCE AND DIMENSION 9 Hrs.

Linear combination of vectors, linear span, linear independence – basis and dimension, dimension of subspaces – Dimension of Quotient spaces.

UNIT 4 INNER PRODUCT SPACE 9 Hrs.

Inner product spaces – Definition – Examples – Applications – Orthogonal complement of a sub space – Orthonormal Basis – Gram Schmidt Orthogonalization process.

UNIT 5 LINEAR TRANSFORMATION 9 Hrs.

Linear Transformation – The Algebra of linear transformations – null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation – Characteristic roots – Canonical forms – Triangular forms.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1 - Define Eigen values and Eigen vectors.
CO2 - Use the Internal direct sum and External direct sum.
CO3 - Analyze the Linear combination of vectors, linear span, linear independence
CO4 - Apply Orthogonal complement of a sub space – Orthonormal & Orthonormal Basis
CO5 - Develop the Algebra of linear transformations
CO6 - Create equations of spheres with various properties

TEXT / REFERENCE BOOKS

1. I.N.Herstein, Topics in Algebra, 2nd Edition, John Wiely, NewYork, 2013.
2. Stephen H.Friedberg, Arnold J.Insel, Lawrence E.Spence, Linear Algebra, 4thEd., Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
3. A.R. Vasistha, A first course in Modern Algebra, Krishna Prakasan, Meerut, 2019.
4. S. Lang, Introduction to Linear Algebra, 2nd Edition, Springer, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1301	COMPUTER ARCHITECTURE AND ORGANIZATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on understand ALU and its operations, types of memory organizations.
- To understand the types of memory organizations, interface and communication in I/O devices.
- To analyze about the characteristics, structure, communication and synchronization of multiprocessors.

UNIT 1 GENERAL REGISTERS 9 Hrs.

Introduction - General Register Organization - Stack organization - Basic computer Organization - Instruction codes - Computer Registers - Computer Instructions - Instruction Cycle.

UNIT 2 ARITHMETIC LOGIC UNIT AND COMPUTER ARITHMETIC 10 Hrs.

Introduction to ALU - Arithmetic – Logic - Shift Micro operations - Arithmetic Logic Shift unit - Example Architectures: MIPS – RISC – CISC - Addition - Subtraction - Multiplication and Division algorithms - Floating Point Arithmetic operations - Micro programmed Control- Design of Control unit

UNIT 3 MEMORY ORGANIZATION 8 Hrs.

Memory Hierarchy - Main memory - Auxiliary Memory - Associative Memory - Cache Memory - Virtual memory

UNIT 4 INPUT - OUTPUT ORGANIZATION 9 Hrs.

Peripheral Devices - I/O Interface - Modes of transfer - Priority Interrupt - DMA - IOP - Serial Communication.

UNIT 5 CHARACTERISTICS OF MULTIPROCESSORS 9 Hrs.

Interconnection Structures - Interprocessor Arbitration - Interprocessor Communication and Synchronization - Cache coherence.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Classify the various types of registers, microinstructions and addressing modes.
CO2 - Explain Arithmetic Logic Unit and computer arithmetic operations.
CO3 - Infer the usage of Memory Organization.
CO4 - Describe about the I/O devices and organization.
CO5 - Explain the interconnection structures and interprocessor communication
CO6 - Describe the characteristics and synchronization of multiprocessors.

TEXT / REFERENCE BOOKS

1. M.Morris Mano, “Computer system Architecture”, 3rd Edition, Prentice-Hall Publishers, 2007.
2. Mark Burrell, “Fundamentals of Computer Architecture”, Mcmillan Higher Education, 2003.
3. John D. Carpinelli, “Computer Systems Organization and Architecture”, Pearson Education, 2001.
4. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, 5th Edition, McGraw-Hill, 2002.
5. William Stallings, “Computer Organization and Architecture - Designing for Performance”, 9th Edition, Prentice Hall, 2012.
6. John P Hayes, Computer Architecture Organization, McGraw Hill Edition 4, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SAIC4003	UNIVERSAL HUMAN VALUES	L	T	P	EL	Credits	Total Marks
		2	0	0	3	3	100

COURSE OBJECTIVES

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- To understand (or developing clarity) the harmony in the human being, family, society and nature/existence.
- To Strengthen Self-reflection, develop commitment and courage to act.

MODULE 1 COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE 2 UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'

7. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
8. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
9. Understanding the characteristics and activities of 'I' and harmony in 'I'.
10. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
11. Programs to ensure Sanyam and Health.

Practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE 3 UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN- HUMANRELATIONSHIP

12. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
13. Understanding the meaning of Trust; Difference between intention and competence
14. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
15. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

16. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from

family to world family.

Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

MODULE 4 UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

17. Understanding the harmony in the Nature
18. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and value in nature
19. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
20. Holistic perception of harmony at all levels of existence.

Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

MODULE 5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONALETHICS

21. Natural acceptance of human values
22. Definitiveness of Ethical Human Conduct
23. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
24. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
25. Case studies of typical holistic technologies, management models and production systems
26. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
27. Sum up.

Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions at the conduct as an engineer or scientist etc.

Total: 28 Lectures and 14 Practice Sessions

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - To become more aware of themselves, and their surroundings (family, society, nature)

CO2 - They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind

CO3 - To have better critical ability

CO4 - To become sensitive to their commitment towards what they have understood (human values, human relationship and human society)

CO5 - To apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

CO6 - To develop professional ethics, foster people-friendly and eco-friendly systems, and contribute to a Universal Human Order through responsible actions in their careers.

TEXT / REFERENCE BOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj – PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

ASSESSMENT:

Assessment by faculty mentor	:	10 Marks
Self-assessment	:	10 Marks
Assessment by peers	:	10 marks
Socially relevant project/Group Activities/Assignments	:	20 Marks
End Semester Examination	:	50 Marks

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1303	THEORY OF COMPUTATION	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

COURSE OBJECTIVES

- To introduce automata theory, regular languages, context free languages and recognizers for different languages.
- To design Turing machines for various languages.
- To gain knowledge on unsolvable problems.

UNIT 1 FINITE AUTOMATA AND REGULAR LANGUAGES 9 Hrs.

Finite automata and regular languages - Regular languages and regular expressions - Finite automata - Non-determinism and Kleene's theorem - non-deterministic finite automata and NFA with null transition.

UNIT 2 CONTEXT-FREE LANGUAGES AND NORMAL FORMS 9 Hrs.

Context-free grammars - Definition - More examples - Union, concatenations, and *'s of CFLs - Derivation trees and ambiguity - Unambiguous CFG for algebraic expressions - Normal Forms - CNF – GNF.

UNIT 3 PUSH DOWN AUTOMATA 9 Hrs.

Pushdown automata - Introduction - Definition - Deterministic pushdown automata - PDA corresponding to a given context-free grammar – Context-free Grammar corresponding to PDA. Pumping Lemma for CFG.

UNIT 4 TURING MACHINES 9 Hrs.

Turing machines - Models of computation and the Turing thesis - Definition of TM and TM as language acceptor - Non-deterministic TM and Deterministic TM – Universal TM.

UNIT 5 RECURSIVE LANGUAGES AND UNDECIDABILITY 9 Hrs.

Recursively enumerable and recursive languages – Properties of Recursively enumerable and recursive languages - Enumerating a language. Introduction to Undecidability- Halting problem- Undecidability of Post correspondence problem (PCP)-Modified PCP -Rice Theorem.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Build solutions for acceptance, rejections problems using Finite State Machine.
CO2 - Perform operations on Context free Languages using context free grammars.
CO3 - Solve problems on Context Free Languages using Push Down Automata.
CO4 - Design a solution for given problems using Turing Machine.
CO5 - Distinguish Recursively Enumerable Languages and Recursive languages.
CO6 - Hypothesize solutions to unsolvable problems.

TEXT / REFERENCE BOOKS

1. John. C. Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw-Hill, 4th Edition, 2010.
2. Hopcroft, Motwani and Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Publishers, Third Edition, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1311	FOUNDATIONS OF ARTIFICIAL INTELLIGENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the various characteristics of intelligent agents
- To learn the different search strategies in AI.
- To learn the concepts of learning and communication in AI.
- To know about the various applications of AI.

UNIT 1 INTRODUCTION AND PROBLEM SOLVING 9 Hrs.

Introduction – Foundations of AI – History of AI – Intelligent agent – Types of agents - Structure – Problem solving agents – Uninformed search strategies – Breadth first search – Uniform cost search – Depth first search – Depth limited search – Bidirectional search – Searching with partial Information.

UNIT 2 INFORMED SEARCH AND GAME PLAYING 9 Hrs.

Informed search – Strategies – A* Heuristic function – Hill Climbing – Simulated Annealing – Constraint Specification problem – Local Search in continuous space – Genetic algorithm – Optimal decisions in games - Pruning – Imperfect decisions –Alpha-Beta pruning – Games that include an element of chance.

UNIT 3 KNOWLEDGE AND REASONING 9 Hrs.

Knowledge based agent – The Wumpus world environment – Propositional logic – Inference rules – First-order logic – Syntax and semantics – Situation calculus – Building a knowledge base – Electronic circuit domain – Ontological Engineering – Forward and backward chaining – Resolution – Truth maintenance system-Mental Events and Mental Objects.

UNIT 4 ACTING LOGICALLY 9 Hrs.

Planning – Representation of planning – Partial order planning –Planning and acting in real world – Acting under uncertainty – Bayes's rules – Semantics of Belief networks – Inference in Belief networks – Making simple decisions – Making complex decisions.

UNIT 5 APPLICATIONS 9 Hrs.

AI applications – Language Models – Information Retrieval- Information Extraction –Fields of Natural Language Processing, Chatbots and its types, Artificially Intelligent Chatbots, Introduction to Chatbot Applications (Retrieval based- Conversation based)-Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - An ability to identify, analyze the search algorithm for the AI problems.
CO2 - Represent a problem using first order logic.
CO3 - Provide the knowledge-based agent to solve the problem.
CO4 - Understand the Informed search strategies.
CO5 - Apply the baye's rule to solve the problem for societal concern.
CO6 - Design user centric applications that use AI concepts.

TEXT / REFERENCE BOOKS

1. Stuart J.Russel, Peter Norvig, “Artificial Intelligence A Modern Approach”, 3rdEdition, Pearson Education,2009.
2. Elaine Rich, Kevin Knight, “Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009.
3. M. Tim Jones, “Artificial Intelligence: A Systems Approach (Computer Science)”, Jones and Bartlett Publishers, Inc., First Edition, 2008.
4. Artificial Intelligence: Foundations of Computational Agents, 2nd Edition, David L. Poole and Alan K.Mackworth, 2010.
5. Introduction to Artificial Intelligence, Ertel, Wolfgang, 1st Edition, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S731BLH32	MACHINE LEARNING ESSENTIALS	L	T	P	EL	Credits	Total Marks
		3	0	2	1	4	100

COURSE OBJECTIVES

- To build a comprehensive understanding of the principles, techniques, and applications of machine learning.
- To analyze classification and clustering techniques.
- To interpret the need for ensembling models and its techniques.
- To apply reinforcement learning techniques.

UNIT 1 INTRODUCTION TO MACHINE LEARNING 12 Hrs.

What is machine learning – Examples of Machine Learning Applications -Types of Machine learning Techniques - Learning a class from Examples - Vapnik-Chervonenkis Dimension - Probably Approximately Correct Learning – Gradient Descent – Bias and Variance- Overfitting- Underfitting- Confusion Matrix.

Practical: Install necessary Library Files, Load Datasets, Load text file or CSV file and convert into Data Frame, Data Preprocessing- Handle missing values-separate dataset into features (X) and labels (y) - Split the dataset into training set and testing set using the train_test_split function from scikit-learn - Implement functions, Input confusion matrix, calculates sensitivity, specificity, and accuracy of various class -understanding Variance and Bias Difference.

UNIT 2 SUPERVISED LEARNING 12 Hrs.

Linear regression-with one variable-with multiple variables--Multiple Linear Regression-Nonlinear Regression-Regression Analysis-Predictive models - Prediction using Logistic Regression-Classification Models-KNN Classification- Naïve Bayes Classification- Decision Tree Classification-Support vector Machine- Random Forest- Classification vs Regression.

Practical: Build Linear Regression Model-Logistic Regression Model-Train Classification Models KNN, Naïve Bayes-Decision tree algorithm to classify a set of data point according to given depth of the tree-Train SVM Model with different Kernel Functions- Train Random Forest with different hyperparameters like the number of trees, maximum depth, minimum samples per leaf.

UNIT 3 UNSUPERVISED LEARNING 12 Hrs.

Clustering-Supervised Learning after Clustering-Density Based Clustering Methods-Hierarchical Based clustering methods-Partitioning methods- Grid based methods. Dimensionality Reduction: Linear Discriminant Analysis -Principal Component Analysis.

Practical: K-Means Clustering to determine optimal number of clusters using techniques like the elbow method or silhouette score-Dendrogram Generation via implementing hierarchical clustering agglomerative or divisive on the dataset- Density-based clustering algorithms DBSCAN, OPTICS-Apply dimensionality reduction techniques LDA, PCA to visualize high-dimensional data.

UNIT 4 ENSEMBLING MODELS 12 Hrs.

Need of Ensembling- Applications of Ensembling – Types of Ensembling: Basic Ensemble Techniques-Advanced Ensemble Techniques: Bagging, Boosting, Stacking, Blending - Techniques of Ensembling - AdaBoost.

Practical: Explore about ensemble learning methods **–** Different ensembling models for classification tasks– Bagging with Random Forest, Boosting with AdaBoost, Stacking and Blending with Logistic regression and KNN-Experiment with different hyperparameters and with different datasets.

UNIT 5 REINFORCEMENT LEARNING 12 Hrs.

Introduction- RL Framework- Temporal Difference Learning -Active Reinforcement Learning- Markov Decision Process Model - Learning Expectations-Learning Algorithms-Q learning Algorithm-Case Study: Implementation of Q learning in automotive games.

Practical: Case Study using Q learning in Automotive Games- Machine learning approaches to develop self-driving cars capable of navigating complex traffic scenarios and ensuring passenger safety-Machine learning model to analyze and classify sentiments in social media data providing valuable insights for businesses regarding customer opinions and preferences.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to:

CO1 - Reduce the dimension of the dataset with machine learning techniques.

CO2 - Implement the predictive analytics for any real-world scenario.

CO3 - Implement applications with clustering and classification techniques.

CO4 - Implement the ensembling models.

CO5 - Learn and apply reinforcement techniques.

CO6 - Apply machine learning models to solve real-world problems, evaluate their performance and make informed decisions about selecting appropriate algorithms.

TEXT / REFERENCE BOOKS

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller, Sarah Guido, First Edition, O'Reilly Media, Inc.
2. Zhi-Hua Zhou, "Ensemble Methods: Foundations and Algorithms", CRC Press, 2012.
3. Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow by Aurélien Géron, Second Edition, O'Reilly Media, Inc.
4. Understanding machine learning: From theory to Algorithms - Shai Shalev-Shwartz, and Shai Ben-David, Published 2014, Cambridge University Press.
5. https://machinelearningmastery.com/stacking-ensemble-machine-learning- with-python.
6. https://sebastianraschka.com/blog/2018/model-evaluation-selection- part4.html.

S12BLH31	PROGRAMMING IN JAVA	L	T	P	EL	Credits	Total Marks
		3	0	2	1	4	100

COURSE OBJECTIVES

- To introduce object-oriented concepts, Packages, Interfaces and Multithreading.
- To understand Input and Output Operations, GUI Programming and Database Connectivity.
- To impart knowledge on the concepts of server side programs.

UNIT 1 JAVA BASICS 12 Hrs.

Features of Java Language - JVM - Bytecode –Data Types-Java Tokens-Access Modifiers-Operators-Arrays one dimensional and multi-dimensional - Control Structures- String Handling – String class – String buffer class.

Practical: Implementation of Matrix Operations using Arrays, String Operations, Looping Control Statements, Conditional Control Statements.

UNIT 2 OBJECT ORIENTED PROGRAMMING 12 Hrs.

Object Oriented Concepts-Classes and Objects –Constructors –. Method Overloading-Inheritance – Types – Using Super – Method Overriding – Abstract Classes – Using final with inheritance- Garbage Collection

Practical: Implementation of Constructors, Inheritance, Static and dynamic Polymorphism, Abstract Class.

UNIT 3 PACKAGES, INTERFACES AND THREADS 12 Hrs.

Introduction to Packages – User Defined Packages - Importing packages – Access protection – Interfaces – Exception Handling – Using try, catch, throw, throws and finally –Java Thread Model – Main thread – Multithreading – Thread priorities – Synchronization.

Practical: Creating custom Packages, Interfaces Handling predefined and User Defined Exceptions, Implementation Single and Multi-Threading.

UNIT 4 FILE STREAMS AND COLLECTIONS FRAMEWORK 12 Hrs.

IO Package - Introduction – Input Stream and Output Stream classes - Data Output Stream and Data Input Stream classes –File Input Stream – File Output Stream. - Reader and Writer Classes – File Reader and File Writer-Collections Framework-List, Set, Map

Practical: Reading Contents From file and Writing Contents to File, Implementation of Collections Frameworks

UNIT 5 GUI PROGRAMMING, DATA BASE CONNECTIVITY, SERVER SIDE PROGRAMMING 12 Hrs.

GUI Programming using Java FX-Explore Events-Accessing Database using JDBC- Introduction to servlet - Servlet life cycle - Developing and Deploying Servlets – JSP TAGS-Expressions-Applications using Servlet and JSP

Practical: Creation of Graphical user Interface for different Applications. Creation of Server-side Programs using Servlet and JSP.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Develop applications using java object-oriented concepts.
CO2 - Create User defined Packages and Interfaces.
CO3 - Build Software using the concepts of Files and Collection Framework
CO4 - Design GUI using Java FX.
CO5 - Implement Java Applications web using Data base Connectivity.
CO6 - Design Web Applications using Servlet and JSP.

TEXT / REFERENCE BOOKS

1. Herbert Schildt, “The Complete Reference JAVA2”, Fifth Edition, Tata Mcgraw Hill, 2017.
2. Bruce Eckel,” Thinking in Java”, Pearson Education, Fourth Edition 2006.
3. Core Java Volume-I Fundamentals, 9th Edition, Cay Horstman and Grazy Cornell,Prentice Hall, 2013.
4. Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015
5. https://docs.oracle.com/javase/tutorial/.
6. https://www.tutorialspoint.com/java

SMTB1402	PROBABILITY AND STATISTICS	L	T	P	EL	Credits	Total Marks
		3	1	0	0	3	100

OBJECTIVE OF THE COURSE

- To identify, reflect upon, evaluate and achieve conceptual understanding and knowledge of traditional Calculus to form independent judgements.
- To model the engineering problems and obtain its solutions mathematically.
- To understand Science, Engineering and Computer Science analytically and improve logical thinking capability.

UNIT 1 BASIC CONCEPTS OF PROBABILITY 9 Hrs.

Probability Space – Events – Axiomatic approach to Probability – Conditional Probability – Independent Events – Baye's Theorem -Random Variables–Functions of Random Variables and their Probability Distribution.

UNIT 2 PROBABILITY DISTRIBUTION 9 Hrs.

Discrete Distributions: Binomial, Poisson and Geometric – Continuous Distributions: Uniform, Exponential and Normal – Applications only (no derivation).

UNIT 3 TWO DIMENSIONAL RANDOM VARIABLES 9 Hrs.

Joint Probability distributions– Marginal and Conditional Distributions–Transformation of Random Variables.

UNIT 4 CORRELATION AND REGRESSION 9 Hrs.

Correlation–Linear regression–Multiple and Partial Correlation–Curve Fitting–Method of Least Squares– Fitting of the Curve of the form $y = a+bx$, $y = a+bx+cx^2$, $z = ax+by+c$.

UNIT 5 ANALYSIS OF VARIANCE AND STATISTICAL QUALITY CONTROL 9 Hrs.

Review of F-test– Design of experiments: Completely Randomized Design, Randomized Block Design and Latin Square Design–Statistical Quality Control: Mean, Range, p, np, c–charts.

Max. 45 Hrs.

COURSE OUTCOMES

.On completion of the course, student will be able to

CO1 - Understand probability concepts and Baye's theorem problems.
CO2 - Analyze discrete and continuous probability distributions.
CO3 - Estimate the distributions and transformations of two-dimensional random variables
CO4 - Distinguish correlation and regression. Construct curve fitting by the method of least squares.
CO5 - Evaluate problems on design of experiments using analysis of variances.
CO6 - Sketch the control charts and point out the results based on the charts

TEXT / REFERENCE BOOKS

1. Hong R.V, Tanis E.A and Zimmerman D L, Probability and Statistical Inference, Pearson Education Limited, 9th Edition, 2015.
2. Miller I and Freund J.E, Probability and Statistics for Engineers, Pearson Publishers, Ninth Edition, 2017.
3. Gupta S C and Kapoor V K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, Tenth Edition,2002.
4. VeerarajanT., Probability, Statistics and Random Processes, Tata McGraw-Hill, New Delhi, Fourth Edition, 2014.

5. Sivaramakrishna Das P., VijayaKumari C., Probability & Random Processes, Pearson Education, 6th Edition, 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1401	OPERATING SYSTEMS AND UNIX	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To have an overview of different types of operating systems and process management.
- To understand the concepts of storage management, I/O and file systems.
- To learn the basics of Unix Programming

UNIT 1 INTRODUCTION 8 Hrs.

Introduction - Operating system structures - System components - OS services - System calls - System structure - Resources Processes - Threads - Objects - Device management - Different approaches - Buffering device drivers.

UNIT 2 PROCESS MANAGEMENT 9 Hrs.

Processes - Process concepts - Process scheduling - Operations on processes - Cooperating processes - CPU scheduling - Basic concepts - Scheduling criteria - Scheduling algorithms - Preemptive strategies - non-preemptive strategies.

UNIT 3 SYNCHRONIZATION AND DEADLOCKS 9 Hrs.

The critical section problem - Semaphores - Classic problems of synchronization - Critical regions - Monitors-Dead locks - Deadlock characterization - Prevention - Avoidance - Detection - Recovery.

UNIT 4 MEMORY MANAGEMENT AND I/O MANAGEMENT 10 Hrs.

Storage Management Strategies - Contiguous Vs. Non-Contiguous Storage Allocation - Fixed and Variable Partition Multiprogramming - Paging - Segmentation - Paging/Segmentation Systems - Page Replacement Strategies - Demand & Anticipatory Paging, File Management: Access Methods - Directory Structure, Allocation Methods, Disk Management: Disk Structure- Disk Scheduling.

UNIT 5 UNIX 9 Hrs.

Unix Components, Internal and External commands, File and directory related commands, File permission and manipulation, Standard I/O, configuring vi environment, Regular expression, Process related commands, Shell programming- Branching control structures- if, case etc., Loop control structures– while, until, for, etc., Jumping control structures – break, continue, exit, etc., Integer and Real arithmetic in shell programs.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the fundamental components of a computer operating system and how computing resources are managed by the operating system.

CO2 - Apply the concepts of CPU scheduling in process management.

CO3 - Analyze synchronization and deadlocks in real computing problems.

CO4 - Demonstrate the different memory and I/O management techniques used in Operating Systems.

CO5 - Gain practical exposure in disk scheduling.

CO6 - Develop shell scripts in vi environment.

TEXT / REFERENCE BOOKS

1. Abraham Silberschatz, Peter Galvin and Gagne, “Operating System Concepts”, 10th Edition, Addison Wesley, 2018.
2. Harvey M.Deitel, ”Operating System”, 3rd Edition, Addison Wesley, 2004
3. Gary Nutt, ”Operating System, A modern perspective”, 3rd Edition, Addison Wesley, 2004.
4. Andrew S. Tanenbaum, “Modern Operating Systems”.4th edition 2015.
5. Eric S. Raymond, Art of UNIX Programming, The 1st Edition, 2003 .

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S11BLH 41	DATABASE MANAGEMENT SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	2	1	4	100

COURSE OBJECTIVES

- To understand the concept of DBMS and ER Modeling.
- To familiarize with normalization, query optimization and relational algebra.
- To apply concurrency control, recovery, security and indexing for the real time data.

UNIT 1 DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE 12 Hrs.

History and motivation for database systems - characteristics of database approach - Actors on the scene - Workers behind the scene - Advantages of using DBMS approach - Data Models, Schema, and Instances - Three-Schema Architecture and Data Independence - The Database System Environment - Centralized and Client/Server Architectures for DBMS - Classification of DBMS.

Practical: Create a database table, add constraints (primary key, unique, check, Not null), insert rows, update and delete rows using SQL DDL and DML commands.

UNIT 2 DATA MODELING 12 Hrs.

Entity Relationship Model: Types of Attributes, Relationship, Structural Constraints - Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity Constraints

Practical: Create a set of tables, add foreign key constraints and incorporate referential integrity.

UNIT 3 SCHEMA REFINEMENT 12 Hrs.

Guidelines for Relational Schema - Functional dependency - Normalization, Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form - Join dependency and Fifth Normal form.

Practical: Query the database tables using different 'where' clause conditions and also implement aggregate functions. Query the database tables and explore sub queries and simple join operations.

UNIT 4 QUERY PROCESSING AND TRANSACTION PROCESSING 12 Hrs.

SQL fundamentals -Translating SQL Queries into Relational Algebra - heuristic query optimization - Introduction to Transaction Processing - Transaction and System concepts - Desirable properties of Transactions - Characterizing schedules based on recoverability - Characterizing schedules based on serializability

Practical: Execute complex transactions and realize DCL and TCL commands.

UNIT 5 CONCURRENCY CONTROL, RECOVERY TECHNIQUES AND NOSQL DBMS 12 Hrs.

Two-Phase Locking Techniques for Concurrency Control - Concurrency Control based on timestamp - Recovery Concepts - Recovery based on deferred update - Recovery techniques based on immediate update -Shadow Paging - Introduction, Need of NoSQL - different NoSQL data models: Key-value stores - Column families - Document databases - Graph databases.

Practical: Create Document, column and graph-based data using NOSQL database tools.

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Demonstrate the basic concept and role of DBMS in an organization.

CO2 - Illustrate the design principles for database design and ER model.

CO3 - Discuss normalization techniques with simple examples

CO4 - Demonstrate the basics of query evaluation and heuristic query optimization techniques.

CO5 - Apply Concurrency control and recovery mechanisms for the desirable database problem.
CO6 - Design the database system with the fundamental concepts of DBMS.

TEXT / REFERENCE BOOKS

1. Silberschatz, A., Korth, H. F., and Sudarshan, S. Database System Concepts, McGraw-Hill, 7th Edition. 2019..
2. Elmasri, R., & Navathe, S. B. Fundamentals of database systems, 4th Edition, Addison Wesley Publishing Edition, 2017.
3. Majumdar, A. K., and Bhattacharyya, P. Database Management Systems. McGraw-Hill, 2017.
4. Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2012.
5. Shashank Tiwari, “Professional NoSql”,Wiley ,2011

SCSB1411	INTRODUCTION TO IOT AND ROBOTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the various means of communication from Node / Gateway to Cloud Platforms.
- To transfer data from IoT devices to various cloud providers and create awareness of various domain specific applications.
- To familiarize with the sensors, drive system, control systems and design a robot work cell for an industrial application.

UNIT 1 INTRODUCTION AND ELEMENTS OF IoT 9 Hrs.

Introduction to IoT- Evolution of IoT - IoT Devices - Trends in the Adoption of IoT - Business Scope, Relation with embedded system – IoT Reference Architecture physical-logical design of IOT-From M2M to IoT - Application Sensors & Actuators - Edge Networking (WSN) Gateways - IoT Communication Protocol – WPAN & LPWA, Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards, Wearable Development Boards.

UNIT 2 IoT AND CLOUD 9 Hrs.

IoT Communication Model - MAC protocol survey -Survey routing protocols-Sensor deployment & Node discovery, Data aggregation & dissemination. Interoperability in IoT - Introduction to Arduino Programming - Integration of Sensors and Actuators with Arduino – Cloud computing in IoT, IoT in cloud architecture- cloud based IoT platforms - IBM Watson, Google cloud – Case Studies: Home automation, Industry applications, Surveillance applications.

UNIT 3 INTRODUCTION TO ROBOTICS 9 Hrs.

Types and components of a robot, Classification of robots, closed-loop and open- loop control systems. Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

UNIT 4 ROBOT KINEMATICS AND DYNAMICS 9 Hrs.

Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics Dynamic Modelling: Equations of motion: Euler-Lagrange formulation.

UNIT 5 ROBOT CONTROL AND ACTUATION SYSTEMS 9 Hrs.

Basics of control: Transfer functions, Control laws: P, PD, PID Non-linear and advanced controls. Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators. Control Hardware and Interfacing: Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications.

Max.45 Hrs.

COURSE OUTCOMES

On Completion of the course, student will be able to

CO1 - Understand general concepts and recognize various devices, sensors and applications.
CO2 - Analyze various M2M and IoT architectures and design issues in IoT applications.
CO3 - Select the appropriate type of tools and grippers for various applications.
CO4 - Design a robotic arm and to bring a controlled movement in the end effectors.
CO5 - Ability to design robot work cell.
CO6 - Develop robots for real life situational problems and think creatively for solutions.

TEXT / REFERENCE BOOKS

1. Boswarthick, Omar Elloumi., The Internet of Things: Applications and Protocols, Wiley publications., 2012
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles., Architecting the Internet of Things, Springer publications.2011.
3. Marco Schwatrz Internet of Things with Arduino Cookbook, Packt Publications.2016.
4. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
5. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.
6. Frank L. Lewis, Darren M.Dawson, Chaouki T.Abdallah, Robot Manipulator Control Theory and Practice Second Edition, Revised and Expanded 2004.
7. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
8. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis ', Oxford University Press, Sixth impression, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSBDPROJ	DESIGN THINKING AND INNOVATIONS	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To apply knowledge in Real time problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to Engineering /Non-Engineering problems.

Activity 1:
Design thinking introduction:

- Phases of design thinking- a study approach
- Group Discussion on Ideation- Users perspective
- Formation of team – Thinking skills- Brain storming

Activity 2:
Problem identification (phase I)

- Selecting user requirements
- Survey on various user's applications
- Specific Problem selection to proceed with the work – Team presentation on identified Problems and various possible solutions.

Activity 3:
Problem identification (Phase II)

- Study of an application and its importance to end user.
- Various models of an applications
- Finalize the identified problem

Activity 4:
Design ideation and various stages

- Sketch design diagram
- Architecture or full diagrammatic study

Activity 5:
Review and upgradation

- Review of the ideation (one to one interaction)
- Feedback
- Upgradation plan

Activity 6:
Implementation (Phase I)

- Build the prototype using available resources
- Record Module diagrams

Activity 7:
Implementation (Phase II)

- Display and review of the prototype.
- Record its functionality and its Usage-Technical manual

Activity 8:
Testing

- To test the product design with real time environment
- Record Process-user manual

Activity 9:
IPR-Activity I

- To study various IPR activities
- To prepare for IPR Process
- To file an IPR

Activity 10:
Start-ups Formation

- To exhibit the product to public: feedback approach
- To prepare full documentation
- Start-ups registration/apply patent/publish paper/submit model/prototype/Apply for seed/submit as research proposal

COURSE OUTCOMES

On Completion of the course, student will be able to

CO1 - Solve real world problems by applying knowledge across domains
CO2 - Develop various design products, processes or technologies for sustainable and socially relevant applications
CO3 - Demonstrate knowledge of resource utilization/budgets to Implement appropriate methodologies
CO4 - Execute tasks by application of engineering standards/ requirements/ design criteria, within timelines
CO5 - Conduct extended investigation that result in the translation of idea to product / production of a research thesis/ developing a proof of concept.
CO6 - Communicate well organized technical and scientific findings effectively in written and oral forms, following ethical and professional norms

TEXT / REFERENCE BOOKS

1. Mueller-Roterberg, Christian. "Handbook of Design Thinking." Hochschule Ruhr West (2018).
2. Design Kit by IDEO.org. "The field guide to human centered design." (2015), ISBN: 978-0-9914063-1-9.
3. https://www.interaction-design.org/literature/article/design-thinking-getting-started-with-empathy
4. https://www.interaction-design.org/literature/article/stage-4-in-the-design-thinking-process-prototype
5. https://www.interaction-design.org/literature/article/test-your-prototypes-how-to-gather-feedback-and-maximise-learning
6. https://uxplanet.org/what-are-insights-aa1f2d1b3b9c
7. https://labs.sogeti.com/using-design-thinking-to-design-business-models/
8. https://www.northeastern.edu/graduate/blog/implementing-business-model-innovation/

COURSE ASSESSMENT METHODS

Direct Methods	Design innovation Reviews Report Submission IPR Registration
Indirect Methods	Course Exit Survey

Assessment Method	Rubrics	Marks allotted	Assessment Type
Review 1	1	30	CAE
Internal Guide	2	10	CAE
IPR Process and Registration	5	10	ESE
Total – Internal		**50**	
Final Review	3	30	ESE
Report Submission	4	20	ESE
Total – External		**50**	

SCSB1501	DATA COMMUNICATION AND COMPUTER NETWORKS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To classify different network architectures, transmission methods and switching techniques.
- To evaluate network errors, examine methods to detect and remove them.
- To articulate the functioning behind the data transfer through different transmission mode in a network.

UNIT 1 INTRODUCTION 9 Hrs.

Data communication process - Components of communication media – Modes of Communication – IEEE protocol and Standards – Network Classifications – Rudiments of Networks topologies – Client Server and Peer to Peer Network Architecture

UNIT 2 TRANSMISSION MEDIA AND SWITCHING 9 Hrs.

Communication Media – Guided transmission, Unguided and Line of Sight (LOS) – Network Connecting Devices - Multiplexing Techniques – Switching Techniques – Packet Switching Techniques – Analog and digital signals – Encoding and modulation – Parallel and serial transmission

UNIT 3 ERROR DETECTION, CORRECTION AND COMMUNICATION 9 Hrs.

Types of Network Errors – Error Detection – Error Correction Methods – Flow control – Error control – IEEE 802.3 – IEEE 802.5 – IEEE 802.11 – IEEE 802.15.1 (Piconet and Scatternet)

UNIT 4 ISDN AND ATM 9 Hrs.

Access to ISDN – ISDN layers – Broadband ISDN – Packet layer protocol – ATM – ATM architecture – ATM layers – Congestion control – Leaky bucket algorithm.

UNIT 5 REFERENCE MODELS AND PROTOCOLS 9 Hrs.

OSI Reference models – Routing algorithms – TCP/IP Layered Architecture – Transport and application layers of TCP/IP – Network Protocols – DHCP – NAT – DNS – SMTP – HTTP – WWW.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Interpret the foundations of communication, network and transmission along with its devices, types, topologies & protocols.

CO2 - Compare different network architectures, transmission methods and switching techniques.

CO3 - Classify various types of network errors, examine methods to detect them and evaluate various correction algorithms to remove it.

CO4 - Apprehend the working of advanced switching network, its protocol and architecture.

CO5 - Deduce the functioning behind the data transfer through different transmission mode in a network.

CO6 - Categorize the classification of layers built in a network and discern the data flow between the layers through diverse range of algorithms.

TEXT / REFERENCE BOOKS

1. Behrouz and Forouzan, “Data Communications and Networking”, 2nd Edition, Tata McGraw Hill, 2007.
2. Andrew.S.Tenenbaum, ”Computer Networks” , 4th Edition, Prentice Hall of India, 2008
3. William Stallings, “Data and Computer Communication “, 6th Edition, Pearson Education, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1511	KNOWLEDGE REPRESENTATION AND REASONING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the foundations of KRR and the tradeoff between representation and reasoning
- To understand which knowledge-based techniques are appropriate for which tasks.
- To apply KRR systems to research and challenging problems.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to Knowledge Base, Models, and Knowledge-Based Agents, Challenges and issues in knowledge representation and reasoning. Nature of Knowledge, Knowledge Acquisition Techniques - Classical Logic.

UNIT 2 LOGIC-BASED KNOWLEDGE REPRESENTATION 9 Hrs.

First-Order Logic: Syntax and Semantics (predicates, variables, quantifiers), First-Order Logic Knowledge Representation Language, Model, Interpretation, Inferences in First Order Logic-Forward Chaining-Backward Chaining. Propositional Logic vs. First-Order Logic.

Universal Instantiation, Existential Instantiation, Substitution and Unification, Generalized MP Rule, Soundness of GMP, Resolution Inference Rule, CNF Logic Programming – Prolog.

UNIT 3 NON-LOGIC-BASED KNOWLEDGE REPRESENTATION 9 Hrs.

Semantic networks: nodes, arcs, and semantic inheritance. Frames and scripts: representing structured knowledge using attribute-value pairs and slots.

Conceptual graphs: graphical representation of knowledge and its formal semantics. Ontologies: introduction to ontology languages (such as RDF, OWL) and their role in representing domain knowledge.

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UNIT 4 KNOWLEDGE REPRESENTATION AND PLANNING 9 Hrs.

Ontological engineering – categories and objects – events – mental objects and modal logic –reasoning systems for categories – reasoning with default information Classical planning – algorithms for classical planning – heuristics for planning – hierarchical planning – non-deterministic domains – time, schedule, and resources – analysis.

UNIT 5 APPLICATIONS OF KRR 9 Hrs.

Case studies in Artificial Intelligence: applications of knowledge representation and reasoning in intelligent systems- Planning, robotics, natural language understanding, and intelligent tutoring systems. – Intelligent Agents – Robotics and Automation.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamental principles and challenges of knowledge representation and reasoning.

CO2 - Review critical properties of a knowledge-based system

CO3 - Analyze and evaluate different formalisms and languages used for representing knowledge.

CO4 - Apply reasoning techniques to derive new knowledge from existing knowledge.

CO5 - Implement knowledge representation systems using logic-based and non-logic-based approaches.

CO6 - Develop different modeling approaches to solve KRR Problems.

TEXT / REFERNCE BOOKS

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Knowledge Representation and Reasoning" by Ronald Brachman and Hector Levesque
3. “Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL" by Dean Allemang and James Hendler.
4. "Knowledge Representation, Reasoning, and the Design of Intelligent Agents: The Answer-Set Programming Approach" by Michael Gelfond and Yulia Kahl.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1513	HUMAN COMPUTER INTERACTION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities
- To model mobile HCI and learn the guidelines for user interface.

UNIT 1 THE COMPONENTS THE HUMAN 9 Hrs.

Human Memory – Thinking – Emotion – Individual Preferences – Psychology and Design of Interactive Systems. The Computer: Text Entry Devices – Pointing Devices – Display Devices – Devices for Virtual Reality and 3D interaction – Physical Controls, Sensors and Special Devices – Memory – Processing and Networks.

UNIT 2 HCI IN THE SOFTWARE PROCESS 9 Hrs.

Interactive Design: Basics – process – scenarios – navigation – screen design –Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design Rules: Introduction – Principles to support usability – Standards – Guidelines – Golden rules and heuristics – HCI patterns

UNIT 3 MODELS AND THEORIES 9 Hrs.

HC I Models: Cognitive models: Socio-Organizational issues and stakeholder requirements - Communication and collaboration models--Hypertext, Multimedia and WWW. Face-to face communication – conversation – text based – group working; Task analysis – difference between other techniques – task decomposition – Knowledge based analysis – ER based techniques –uses

UNIT 4 IMPLEMENTATION SUPPORT 9 Hrs.

Windowing system elements – using tool kits – user interface management; Evaluation techniques – goals – expert analysis – choosing a method; universal design principles – multimodal interaction; user support – requirements – Approaches – adaptive help systems – designing user support systems.

UNIT 5 WEB INTERFACE DESIGN 9 Hrs.

Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow – Case Studies.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Design effective dialog for HCI
CO2 - Design effective HCI for individuals and persons with disabilities.
CO3 - Assess the importance of user feedback.
CO4 - Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
CO5 - Develop meaningful user interface.
CO6 - Analyze and identify user models and the appropriate tools.

TEXT / REFERENCE BOOKS

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, Human Computer Interaction, 3rd Edition, Pearson Education, 2004.
2. Human Computer Interaction, Springer publications,2018.

3. Brian Fling, Mobile Design and Development, First Edition, OReilly Media Inc., 2009
4. Bill Scott and Theresa Neil, Designing Web Interfaces, First Edition, OReilly, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S731BLH51	BIG DATA ANALYTICS FOR AI	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVES

- To study the tools required to manage and analyze big data.
- To explore the concept of knowledge representation
- To learn planning strategies, learning techniques and logistic regression

UNIT 1 INTRODUCTION TO BIG DATA 12 Hrs.

Introduction - Challenges of Conventional Systems, What is Business Analytics, Business Analytics lifecycle, Why Big Data Analytics, Defining Big data, Characteristics of Big Data(V's), Business Analytics phases: Data Acquisition- Data Cleaning - Data Manipulation - Data Analysis (Statistical and Analytical methods) to make sense of data - Data Visualization

PRACTICAL

- Data Pre-Processing: Building Good Training Sets
- Manipulate the Twitter Data Set.

UNIT 2 HADOOP MAPREDUCE 12 Hrs.

Introduction to HADOOP - Hadoop ecosystem components and uses, Hadoop Storage: HDFS, Concept of Hadoop Distributed file system, Design of HDFS, Configuration of HDFS. Hadoop Data Types, large-scale deep belief nets with MapReduce - Functional Concept of Mappers, Functional-Concept of Reducers, MapReduce Execution Framework, Partitioners and Combiners, Hadoop Clusters component : NameNode, Secondary NameNode, and DataNode, Data flow (Anatomy of File Write and Read) - detecting malicious domain using deep Learning at scale.

PRACTICAL

- Hadoop – Map Reduce Programs / Commands / Job Scheduling
- HDFS
- 3.YARN
- Working with Pig and Hive

UNIT 3 KNOWLEDGE REPRESENTATION 12 Hrs.

Issues, predicate logic, resolution, representing knowledge using rules, forward versus backward reasoning, matching, control knowledge, weak slot and filler structure-semantic nets, frames, strong slot - learning curve analysis by logistic regression

PRACTICAL

- Evaluating the results of machine learning algorithms
- Implement Regression and Correlation Techniques

UNIT 4 GAME PLAYING 12 Hrs.

Mini-max search, alpha-beta cutoffs, planning system, goal stack planning, hierarchical planning, understanding as constraint satisfaction, waltz algorithm, natural language processing, syntactic processing - scalable multi-dimensional prediction model

PRACTICAL

- Implement Classification Algorithms
- Implement Naïve Bayes Classifier

UNIT 5 LEARNING 12 Hrs.

Rote learning, learning by taking advice, learning in problem solving, learning from examples, Winston's learning program, decision trees, perception, vision, speech recognition, navigation, manipulation, robot architecture - data analytics using scalable logistic regression - sentimental classification of big data using logistic regression

PRACTICAL

- No SQL (using Cassandra/MongoDB/Spark)
- Visualization (using Tableau)

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the key issues in big data management.
CO2 - Acquire various analytic techniques, software tools.
CO3 - Analyze various AI approaches to solve problems.
CO4 - Learn various classification techniques in big data analytics.
CO5 - Design models for real world scenarios.
CO6 - Design a case study and retrieve the patterns from large data to solve complex tasks.

TEXT / REFERENCE BOOKS

1. Distributed Databases: Principles and Systems Paperback – 1 Jul 2017 by Stefano Ceri , Giuseppe Pelagatti , McGraw Hill Education, ISBN-10: 0070265119, ISBN-13: 978-0070265110, 2017.
2. Tom White "Hadoop: The Definitive Guide" Fourth Edition, O"reilly Media, 2015
3. Prajapati, V. Big data analytics with R and Hadoop. Packt Publishing Ltd, 201
4. E.RichK.Knight, and B. Nair, Artificial Intelligence, 3rdEdition, TMH, 1 July 2017
5. Russel Norvig, Artificial Intelligence A modern Approach, 3 rd Edition, Pearson Education,2010

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 Exam Duration: 3 Hrs.

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB1611	COMPUTATIONAL INTELLIGENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand concepts, paradigms, algorithms of CI and its constituent methodologies.
- To emphasize on practical applications throughout, that is, how to apply the concepts, paradigms, algorithms and implementations discussed to practical problems in engineering and computer science.
- To introduce the basic tools and techniques in Computational Intelligence such as Neural Networks and Genetic algorithms.

UNIT 1 ARTIFICIAL NEURAL NETWORKS 9 Hrs.

The Artificial Neuron - Supervised Learning Neural Networks-Supervised Learning rules -Unsupervised Learning Neural Networks-Reinforcement Learning–Learning through awards-Model free Reinforcement Learning– Performance Measures Performance Factors.

UNIT 2 EVOLUTIONARY COMPUTATION 9 Hrs.

Introduction to Evolutionary Computation-Genetic Algorithms-Genetic Programming–Basic Evolutionary Programming–Generic Evolution Strategy Algorithm–Basic Differential Evolution–Basic Cultural Algorithm- Belief Space–Convolution Applications of various evolutionary computation techniques.

UNIT 3 SWARM INTELLIGENCE 9 Hrs.

Basic Particle Swarm Optimization–Social Network Structures-Basic Variations-Basic PSO Parameters-Ant Colony Optimization–Ant Algorithms-Simple Ant Colony Optimization Algorithm-Ant System–Ant Colony System- Max-Min Ant System-Basic Artificial Bee Colony Algorithm.

UNIT 4 ARTIFICIAL IMMUNE SYSTEMS 9 Hrs.

Natural Immune System-Learning the Antigen Structure-Artificial Immune System Algorithm-Classical View Models-Clone Selection Theory Models-Network Theory Models-Artificial Immune Network-Adapted artificial Immune Network.

UNIT 5 FUZZY SYSTEMS 9 Hrs.

Fuzzy Sets-Fuzzy Logic and Reasoning-Fuzzy Inferencing- Fuzzy Controllers-Mamdani Fuzzy Controller-Takagi- Sugeno Controller–Introduction to Rough sets.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the concepts and principles of computational intelligence.
CO2 - Implement various algorithms and model intelligent systems.
CO3 - Analyze various algorithms and select suitable method.
CO4 - Apply optimization techniques such as evolutionary, swarm optimization and genetic algorithms.
CO5 - Design models for real world scenarios.
CO6 - Implement complex problems and group projects.

TEXT / REFERENCE BOOKS

1. Andries P Engelbrecht," Computational Intelligence ", Wiley Publications, 2nd Edition.
2. Leszek Rutkowski, "Computational Intelligence Methods and Techniques"– Springer 2008.
3. Lakhmi C.Jain, "Computational Intelligence Paradigms Innovative Applications" – Springer 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration:3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1612	PREDICTIVE AND ADVANCED ANALYTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn the concepts and applications of data mining
- To explore the Automated Models for Categorical and Continuous targets
- To analyze the performance in different models.

UNIT 1 INTRODUCTION TO DATA MINING 9 Hrs.

Introduction to Data Mining **-** Concepts of Data mining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on various kinds of data, Applications of Data Mining, Challenges of Data Mining.

UNIT 2 DATA UNDERSTANDING AND PREPARATION 9 Hrs.

Introduction, Reading data from various sources, Data visualization, Distributions and summary statistics, Relationships among variables, Extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation, Combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, Missing Values.

UNIT 3 MODEL DEVELOPMENT AND TECHNIQUES 9 Hrs.

Data Partitioning- Model selection, Model Development Techniques, Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine, Bayesian Networks, Linear Regression, Cox Regression, Association rules.

UNIT 4 MODEL EVALUATION AND DEPLOYMENT 9 Hrs.

Introduction, Model Validation, Rule Induction Using CHAID, Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, Metalevel Modeling

UNIT 5 DEPLOYING MODEL 9 Hrs.

Assessing Model Performance, updating a Model, Bias, Variance and model complexity, Bias-variance trade off, Optimism of the training error rate, Estimate of In-sample prediction error

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, the student will be able to

CO1 - Understand the process of formulating business objectives, data selection/collection
CO2 - Successfully design, build, evaluate models
CO3 - Implement predictive models for various business applications.
CO4 - Compare the underlying predictive modeling techniques.
CO5 - Select appropriate predictive modeling approaches to identify cases to progress with.
CO6 - Deploy model and assess the performance

TEXT / REFERENCE BOOKS

1. Predictive & Advanced Analytics (IBM ICE Publication)
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning-Data Mining, Inference, and Prediction Second Edition, Springer Verlag, 2009.
3. C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006
4. L.Wasserman,"All of statistics-A Concise Course in statistical inference", Springer Text in Statistics, October 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1451	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the foundational concepts of neural networks and deep learning.
- To explore various activation functions and loss functions.
- To investigate applications of CNNs and RNNs.

UNIT 1 NEURAL NETWORKS 9 Hrs.

Introduction – Artificial Neurons- Neuron structure and functionality - Types of neural networks, Hebbian Learning-Perceptron's-Limitations of Linear nets and perceptron's-Activation Functions-Error Function-Loss Function-Neural Network Architectures – Single Layer-Multi Layer-Deep Networks.

UNIT 2 SUPERVISED AND UNSUPERVISED NETWORKS 9 Hrs.

Supervised Learning Networks - Adaptive Linear Neuron, Back-propagation Network. Associative Memory Networks. Training Algorithms for pattern association, BAM and Hopfield Networks.

Unsupervised Learning Network - Fixed Weight Competitive Nets, Maxnet, Hamming Network, Kohonen Self-Organizing Feature Maps, Adaptive Resonance Theory Networks.

UNIT 3 CNN and RNN 9 Hrs.

CNN: Introduction-Convolution and Pooling Layers-CNN Architectures (LeNet, AlexNet, VGG, ResNet)-Object Detection and Localization with CNNs-Image Classification and Transfer Learning-Case Studies: Image Recognition and Analysis

RNN: Introduction- Vanishing and Exploding Gradients - LSTM (Long Short-Term Memory) Networks-GRU (Gated Recurrent Unit) Networks-Applications of RNNs: Sequence Prediction, Language Modeling, and Text Generation-Time Series Analysis and Forecasting.

UNIT 4 DEEP LEARNING 9 Hrs.

Introduction to Deep Learning, Historical Trends in Deep learning- Autoencoders and Dimensionality Reduction- Generative Adversarial Networks (GANs)-Reinforcement Learning and Deep Q-Networks (DQN)-Attention Mechanisms and Transformer Networks-Transfer Learning.

UNIT 5 CASE STUDY 9 Hrs.

Implementing Neural Networks and Deep Learning Models using Frameworks like TensorFlow or PyTorch, Case Studies: Image Recognition and Analysis- Object Recognition in Video Streams-Sequence Prediction- Sentiment Analysis- Text Classification - Named Entity Recognition (using NLTK Library).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - To understand the concepts of Neural Networks
CO2 - To differentiate supervised and unsupervised learning networks.
CO3 - To implement SOM and ART Algorithms.
CO4 - To differentiate various types of neural networks, feedforward, convolutional, recurrent, and deep networks
CO5 - To implement neural networks and deep learning models using various frameworks.
CO6 - To choose appropriate neural network architectures and techniques for specific applications.

TEXT / REFERENCE BOOKS

1. Deep Learning: An MIT Press Book by Ian Goodfellow and Yoshua Bengio and Aaron Courville, Publisher-Alanna Maldonado, 2016.
2. Neural Networks and Deep Learning: A Textbook by Charu Aggarwal, Springer International Publishing,2023.
3. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall,2009.
4. Deep Learning for Computer Vision, Expert Techniques to Train Advanced Neural Networks using TensorFlow and Keras by Rajalingappaa Shanmugamani, Packt Publishing, 2018.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100 **Exam Duration:3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S731BLH61	NATURAL LANGUAGE PROCESSING	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVES

- To understand language modeling and word level analysis.
- To understand the way to measure one or more qualities of an algorithm or a system.
- To gain knowledge of the linguistics concerned with syntactic analysis and represent semantics and pragmatics.

UNIT 1 OVERVIEW AND LANGUAGE MODELLING 12 Hrs.

Overview: Origins and challenges of NLP Language and Grammar-Processing Indian Languages- NLP Applications Information Retrieval. Language Modeling: Various Grammar- based Lanuage Models-Statistical Language Model, The role of Machine Learning in NLP.

PRACTICAL

Create BoW preprocessing function and identify the importance of words in the BoW Model using the following three Techniques:

- Count Vector Model
- Term Frequency Vector Model
- Term Frequency-Inverse Document Frequency (TF-IDF) Model

UNIT 2 WORD LEVEL ANALYSIS 12 Hrs.

The role of language models, Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models

PRACTICAL

Implement the following steps to generate words using Python.

- Importing dependencies
- Loading and mapping data into Python
- Analysing text
- NLP modelling and text generation.

Implement Decision Tree Classifier to classify whether a customer can be given bank loan or not based on the following classification features.

- Age
- Credit balance
- Applicant job status
- Owning House or not

UNIT 3 SYNTACTIC ANALYSIS 12 Hrs.

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.

PRACTICAL

Identify the given product review is fake or Genuine by applying the following classification algorithms.

- Naïve Bayes Classifier
- SVM classifier

UNIT 4 SEMANTICS AND PRAGMATICS 12 Hrs.

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

PRACTICAL

Implement POS tagging using the following steps.

- Tokenize text (word_tokenize)
- apply pos_tag to above step that is nltk.pos_tag(tokenize_text)

UNIT 5 DISCOURSE ANALYSIS AND LEXICAL RESOURCES 12 Hrs.

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brills Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

PRACTICAL

- Building Chunker

Max. 60 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand NLP problems and survey the literature about that problem
CO2 - Implement language modeling
CO3 - Describe automated natural language generation and machine translation
CO4 - Identify the algorithms for different real world datasets.
CO5 - Analyze the logic and semantics of world knowledge.
CO6 - Compare the use of different statistical approaches for different types of NLP applications.

TEXT / REFERENCE BOOKS

1. Richard M Reese, ―Natural Language Processing with Java, OReilly Media, 2015
2. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition,Chapman and Hall/CRC Press, 2010.
3. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.

SCSB2611	AI AND VISUALIZATION LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To apply ML algorithms for classifying the data
- To identify the pattern in text data
- To visualize the data using different data visualization approaches.

SUGGESTED LIST OF EXPERIMENTS

1. Techniques for Data Preprocessing: Mean Removal, Scaling, Normalization
2. Classification Techniques: Naïve Bayes Classifier, SVM, Logistic Regression, Decision Tree, Random Forest
3. K-Means Clustering algorithm
4. NLTK – implementation of Tokenization, Stemming, and Lemmatization
5. Building a Bag of Words Model in NLTK
6. Topic Modeling: Identifying Patterns in Text Data
7. Analyzing Sequential Data by Hidden Markov Model (HMM)
8. Concept of Heuristic Search in AI
9. A Bot to Play Tic Tac Toe
10. Single - Layer Neural Networks, Multi-Layer Neural Networks
11. Building Linear Regression using ANN
12. Image Classifier: An Application of Deep Learning

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Use appropriate tools for analyzing text data
CO2 - Classify the data according to the customer requirement
CO3 - Analyze the time series data semantics of a text document.
CO4 - Predict the hidden pattern using the given dataset.
CO5 - Apply deep learning algorithms for a given application.
CO6 - Design an intelligent system using AI algorithms

SCSB1712	COMPUTER VISION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the basic principles of image formation and image processing algorithms.
- To emphasize the core vision tasks of scene understanding and recognition.
- To discuss applications to 3D modeling, video analysis, and video surveillance, objects recognition and vision-based control.

UNIT 1 INTRODUCTION 9 Hrs.

Image Processing, Computer Vision and Computer Graphics, what is Computer Vision - Low-level, Mid-level, High-level, Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality

UNIT 2 IMAGE FORMATION MODELS 9 Hrs.

Monocular imaging system, Radiosity: The 'Physics' of Image Formation, Radiance, Irradiance, BRDF, color etc, Orthographic & Perspective Projection, • Camera model and Camera calibration, Binocular imaging systems, Multiple views geometry, Structure determination, shape from shading, Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

UNIT 3 IMAGE PROCESSING AND MOTION ESTIMATION 9 Hrs.

Image preprocessing, Image representations (continuous and discrete), Edge detection. Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.

UNIT 4 SHAPE REPRESENTATION AND SEGMENTATION 9 Hrs.

Contour based representation, Region based representation, Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, and Multiresolution analysis.

UNIT 5 OBJECT RECOGNITION AND IMAGE UNDERSTANDING 9 Hrs.

Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component Analysis, Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM, Application: Surveillance – foreground background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Implement fundamental image processing techniques required for computer vision
CO2 - Understand Image formation process
CO3 - Extract features form images and do analysis of images
CO4 - Generate 3D model from images
CO5 - Understand video processing, motion computation and 3D vision and geometry
CO6 - Develop applications using computer vision techniques

TEXT / REFERENCE BOOKS

1. David A. Forsyth, Jean Ponce."Computer Vision: A Modern Approach", 2nd Edition Pearson Education Limited, 2015.
2. E. Trucco and A. Verri, "Introductory Techniques for 3D Computer Vision", Prentice Hall, 1998.
3. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, 2012.
4. E. R. Davies, Computer & Machine Vision, 4th Edition, Academic Press, 2012.
5. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA). Springer, 2010.
6. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB2752	COMPUTER VISION LAB	L	T	P	EL	Credits	Total Marks
		0	0	4	0	2	100

COURSE OBJECTIVES

- To introduce techniques of computer vision and pattern recognition
- To understand the design issues of computer vision and object recognition systems
- To provide the programming experience from implementing computer vision and object recognition applications.

SUGGESTED LIST OF EXPERIMENTS

1. Basic Image Handling and Processing video using OpenCV
2. Creating a 3D Model From 2D Images
3. Basic motion detection and tracking
4. Image captioning
5. Build your own Vehicle Detection Model
6. Contour based Segmentation
7. Region based Segmentation
8. Developing Social Distancing application
9. Implementation of Shape Detection using Hough Transform
10. Perform Face Detection on Your Family Photos
11. Scene Text Detection
12. Road Lane Detection in Autonomous Vehicles
13. Emotion Recognition through Facial Expressions
14. Build a People Counting Solution
15. Count Vehicles in Images and Video
16. Build a QR Code Scanner

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Recognize and describe both the theoretical and practical aspects of computing with images.

CO2 - Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.

CO3 - Become familiar with the major technical approaches involved in computer vision.

CO4 - Gain exposures to advanced concepts leading to object categorization and segmentation in images.

CO5 - Build computer vision applications.

CO6 - Apply 3D modeling techniques to real time applications

SCSB3411	AI FOR GAMING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To provide an in-depth introduction to technologies and techniques used in the game industry
- To Understand the issues and role of AI in the design of games
- To understand tactical and strategic AI for games

UNIT 1 INTRODUCTION TO GAME AI 9 Hrs.

Introduction – Nature of Game AI – Models of game AI – AI Engine structure – representations, complexity, and constraints – Analytical Geometry 1

UNIT 2 MOVEMENT ALGORITHMS AND STEERING BEHAVIOUR 9 Hrs.

Simple State Machines – Computational Geometry – Kinetic and Dynamic Movement – Steering and combining steering – Analytical Geometry 2

UNIT 3 COORDINATED MOVEMENT, MOTOR CONTROL AND PATHFINDING 9 Hrs.

Interaction with Physics engine – Jumping – Coordinated movement – Motor Control – Pathfinding: pathfinding graphs – Dijkstra A* – hierarchical pathfinding – motion planning

UNIT 4 DECISION MAKING, TACTICS AND LEARNING 9 Hrs.

Decision Making: Decision tree – State Machines – Fuzzy Logic Markov Systems – Goal-oriented behavior – Rule-based systems – black board architectures – Tactics and Strategy: waypoint tactics, tactical analyses, tactical pathfinding, coordinated action

UNIT 5 LEARNING AND GAME PLAYING 9 Hrs.

Learning: Decision tree learning, Naive Bayes, Reinforcement learning, Artificial Neural Networks – Game Playing: game theory, minimax, transposition tables, opening books and set plays, turn-based strategy games.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Identify tasks that can be tackled using AI techniques.
CO2 - Select the appropriate AI technique for the problem under investigation.
CO3 - Design and implement efficient and robust AI algorithms for game tasks.
CO4 - Develop AI game engines.
CO5 - Evaluate performance and test the implemented algorithms.
CO6 - Apply learning solutions to real world gaming techniques.

TEXT / REFERENCE BOOKS

1. Artificial Intelligence for Games, 2nd edition, by Ian Millington and Morgan Kaufmann, 2009.
2. Ian Millington, ”AI for Games”, CRC Press, Taylor and Francis Group,2022.
3. David M Bourg, Glenn Seemann,” AI for Game Developers”, O'Reilly Media, 2004.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 Exam Duration: 3 Hrs.

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3412	AUGMENTED REALITY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the principles and multidisciplinary features in augmented reality.
- To design the technology for multimodal user interaction and perception in AR.
- To implement different technology for managing large scale AR environment in real time.
- To develop and interact with applications based on AR system frameworks.

UNIT 1 INTRODUCTION TO AR 9 Hrs.

Digital enhancement, physical enhancement, Registration with the Physical World, Person in the Physical World, e Spectrum Between Real and Virtual Worlds- Process of Augmented Reality Applications, Sensor(s), processors, display - Computer Graphics, Dimensionality, Depth Cues, Registration and Latency -Ingredients of an Augmented Reality.

UNIT 2 AUGMENTED REALITY HARDWARE 9 Hrs.

Components for Augmented Reality Systems – roles of sensors – tracking, optical tracking, Acoustical, Electromagnetic, Mechanical Tracking, Multiple Sensors, Role of processors – Architecture, handled, desktop, web applications, graphic accelerators, network bandwidth, displays - Visual, Audio, Haptic, sensory, Stereo display.

UNIT 3 AUGMENTED REALITY SOFTWARE 9 Hrs.

Environmental acquisition, Sensor integration, Application engine, rendering software, Augmented reality libraries- cross platform, creating and editing three-dimensional graphics, two-dimensional graphics, creating and editing sound, Precompute Sounds Using Software Outside the AR Application

UNIT 4 AUGMENTED REALITY CONTENT 9 Hrs.

Attributes, physical, conceptual representation, telling stories, AR games, Conveying Information, visual content, three dimensional objects, two dimensional images, animation, audio content, content for touch, taste and smell, representation of senses, sight, hearing.

UNIT 5 INTERACTION WITH AUGMENTED REALITY 9 Hrs.

Real world interaction, Manipulation, Navigation, Communication, Projected Augmented Reality Environments, Subjective vs Objective. Mobile augmented reality- advantage and disadvantages, Architecture, Augmented Reality Applications, Magic Books, Magic Mirrors.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the hardware and software AR system.
CO2 - Implement the Augmented Reality software.
CO3 - Analyze and design the framework in AR using various software development tools in AR.
CO4 - Design the multi modal user interface.
CO5 - Describe the principles and features of AR.
CO6 - Recognize the technologies used to manage the large-scale AR real time systems.

TEXT / REFERENCE BOOKS

1. Understanding Augmented Reality, Alan B. Craig, 2013
2. Augmented Reality: Principles and Practice, Tobias Höllerer, Dieter Schmalstieg, 2016
3. Augmented Reality: Where We Will All Live, Jon Peddie, 2017
4. Augmented Reality: An Emerging Technologies, Joseph Rampolla, Gregory Kipper,2012

5 Augmented Reality, Günter Abel and James Conant, 2017

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3413	MATHEMATICS FOR INTELLIGENT SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts and techniques of linear algebra, calculus and basic probability theory
- To explore the concepts through computational experiments and implement these wide applications within the scientific field.
- To design applications within business and scientific domains.

UNIT 1 LINEAR ALGEBRA 9 Hrs.

Highlights of Linear Algebra: Four Fundamental Spaces, Eigenvalues and Eigenvectors, SVD, PCA and best low rank matrix. Raleigh Quotients and Generalized Eigenvalues, Norms of vectors and matrices, Factoring matrices and tensors. Computation with Large matrices: Krylov subspaces and Arnoldi iteration, Linear System solution by Arnoldi and GMRES, Conjugate gradient method.

UNIT 2 THEORY OF OPTIMIZATION 9 Hrs.

(Convex and Non-convex basics) - Unconstrained optimization methods, Direct methods for convex functions, sparsity inducing penalty functions, Newton methods for non-convex functions. Constrained Convex Optimization problems, Formulating problems as LP and QP, support vector machines, solving by packages (CVXOPT), Lagrangian multiplier method, KKT conditions, Introduction to Alternating direction method of multipliers- the algorithm. Kalman Filter, Optimal Sensor based Control, Full state Feedback of Cartpole Pendulum, Robust Control and Frequency domain Techniques

UNIT 3 SIGNAL PROCESSING 9 Hrs.

Applications in signal processing and pattern classification. Introduction to PDEs arising in Physics and Engineering (problem formulations and simple numerical methods for solutions).

UNIT 4 NEURAL NETWORKS 9 Hrs.

Gradient Descent, Stochastic gradient descent and ADAM (adaptive methods), Loss function The Construction of Deep Neural Networks, CNNs, Back propagation and Chain Rule, Hyper Parameters, The world of Machine learning.

UNIT 5 PROBABILITY AND STATISTICS 9 Hrs.

Probability and statistics - Moments, cumulants, and inequalities of statistics, Covariance matrices and joint probabilities, Multivariate Gaussian and weighted least squares, Markov chains, Markov decision process - advanced aspects. Expectation- Maximization, Variational Inference, Variational Learning, Support Vector Machines, Neural Networks, Bayesian Modelling.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - To develop an understanding of the basic concepts and techniques of linear algebra, calculus and basic probability theory needed for AI

CO2 - To provide an appreciation of the wide application of these disciplines within the scientific field.

CO3 - To provide connection between the concepts of linear algebra, differential equation and probability theory

CO4 - To develop an insight into the applicability of linear algebra in business and scientific domains.

CO5 - To enable the students to understand the use of calculus and Linear algebra in modelling electrical and mechanical elements.

CO6 - To equip the students to understand the role of probability theory in providing data sets for computational experiments in data science

TEXT / REFERENCE BOOKS

1. 'Linear Algebra and learning from data', Gilbert Strang, Wellesley, Cambridge press, 2019
2. 'Data Driven Science and Engineering', Steve Brunton and Nathan Kutz, Cambridge University Press, 2018 'Machine Learning: A Probabilistic Perspective', Kevin Murphy and Francis Bach, 2012
3. Differential Equations and Linear Algebra', Gilbert Strang, Wellesley, Cambridge press, 2018.
4. 'Linear Algebra and learning from data', Gilbert Strang, Wellesley, Cambridge press, 2019.
5. 'Convex Optimization', Stephen Boyd and Lieven Vandenberghe, Cambridge University Press, 2018

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3642	INTELLIGENT ROBOTS AND DRONE TECHNOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To explore the knowledge of intelligent robots
- To implement the mechanism of drone technology in commercial applications.
- To develop drone applications in the future irrespective of environment.

UNIT 1 INTRODUCTION 9 Hrs.

Overview of robotics - Robotics in AI - Embedded Systems – Agent Task Environment Model-Embodied Systems - Sensors and signal processing - Planning approaches to robot control: STRIPS and SHAKEY- Robot manipulator kinematics.

UNIT 2 APPROACHES 9 Hrs.

Control Theory: Feedback, feed forward and open loop control - Linear first order lag processes - Limitations of control theory- Probability Based Approaches: Markov Decision Processes (MDPs) - Navigation - Behaviour-Based Control: The subsumption architecture - Hybrid architectures – Formalising behaviour-based control (SMDPs) - Adaptive approaches to robot control- Reinforcement learning for control- Model Based learning approaches to control- Learning maps - Evolutionary approaches.

UNIT 3 DRONE TECHNOLOGY 9 Hrs.

Drone Concepts - Terminologies - History of drone - Types of current generation of drones based on their method of propulsion - Drone design and fabrication: Classifications of the UAV - Overview of the main drone parts technical characteristics of the parts Function of the component parts.

UNIT 4 DRONE PROGRAMMING 9 Hrs.

Drones' configurations the methods of programming drone Download program Install program on computer Running Programs Multirotor Stabilization Flight modes - Drone flying and operation: Concept of operation for drone Flight modes - Drone accessories - Sensors - Onboard storage capacity Removable storage devices Linked mobile devices and applications.

UNIT 5 DRONE MAINTANENCE 9 Hrs.

Drone commercial applications: Drones in agriculture - Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing - Future of drones: Miniaturization of drones - Increasing autonomy of drones - The use of drones in swarms.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - To understand the basics behind robotics and embedded system
CO2 - To learn basic approaches behind robotic controls
CO3 - To list out different terminologies and concept behind drone
CO4 - To design and develop programs for drone movement and configuration
CO5 - To apply drone technology for various commercial applications
CO6 - To develop drones for real time societal needs

TEXT / REFERENCE BOOKS

1. Nitin goyal, Sharad Sharma, Arun Kumar Rana, Suman Lata Tripathi, Internet of Things Robotics and Drone Technology, CRC press, 2021
2. Neil Wilkins, Robotics: What beginners need to know about robotic process automation, mobile robots, artificial intelligence, machine learning, autonomous vehicles, speech recognition, drones and our future, independently published, 2019

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3038	ADVANCED COMPUTER NETWORKS	L	T	P	EL	Credits	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVES

- To introduce topics related to computer networks and internet operating system
- To gain knowledge on how to develop products.
- To understand basics of Linux Kernel Architecture where the network devices based on and its interface with various products developed for these devices.

UNIT 1 LINUX KERNEL 9 Hrs.

Linux Kernel Programming Introduction, Static & Dynamic Linking of modules, User vs Kernel Space, Systems Calls, Makefile for modules. Shell Programming.

Programming Assignments**:** Writing shell programs related to shell function, line count of several files and wait and sleep commands.

UNIT 2 NETWORK DRIVERS 9 Hrs.

Introduction to Network Device Drivers. Character Device Driver Development, Process Synchronization and Scheduling, Interrupt Handling, Kernel Debugging.

Programming Assignments: Writing a kernel program, compiling and inserting and removing a module in kernel.

UNIT 3 eBPF - NETWORKING AND SECURITY 9 Hrs.

Basics of eBPF, Packet Filters basics, Introduction to Kernel's Traffic Control Layer, Use of C for eBPF

Programming Assignments: Writing a simple C program to interact with eBPF using syscall.

UNIT 4 NETWORK OPERATING SYSTEM PROGRAMMING MODULE 9 Hrs.

Introduction to Internet Operating System. Basics of Cisco IOS XR7, Cisco IOS and Open Network Linux. Socket basics, basics of Client-Server Architecture, Basics of Overlay Networking and Virtualization, Content Delivery Networks and Network Automation.

Programming Assignments: Writing a simple C program on SNULL (Simple Network Utility for Loading Localities). Writing a C program to capture network packets.

UNIT 5 NETWORK DRIVERS TESTING 9 Hrs.

Socket basics, Loopback Addressing, Structure of SNULL (Simple Network Utility for Loading Localities)

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the fundamentals of Linux Kernel architecture.
CO2 - Develop products related to advanced computer networks.
CO3 - Deep knowledge in structure of networks to the protocol content and usage level.
CO4 - Understand the internet operating systems running in routers and switches
CO5 - Develop products run in these networks and network devices.
CO6 - Test and maintain the products run in the networks.

TEXT / REFERNCE BOOKS

1. Robert Love, Linux Kernel Development, 3rd edition, Addison Wesley, 2010, ISBN: 8131758184.
2. Andrew S.Tanenbaum, David J.Wetherall, Computer Networks, 5th Edition, Pearson, ISBN-13: 978-0-13-212695-3

3. M J Bach, The Design of the Unix Operating System, 1st edition, Pearson Education,2015, ISBN:9332549575.
4. J Cooperstein, Writing Linux Device Drivers - A Guide with Exercises, Create space, 2009, ISBN: 1448672384.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3451	INTERPRETABLE MACHINE LEARNING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the machine interpretability methods.
- To develop ML models that are unbiased in predictions, robustness and trustable.
- To design advanced models of machine interpretation.

UNIT 1 MACHINE INTERPRETATION 9 Hrs.

Introduction – Machine Learning Terminology – Importance of Interpretability – Taxonomy and scope of Interpretability Methods – Evaluation of Interpretability – Explanations.

UNIT 2 ML MODELS 9 Hrs.

Interpretable models: Linear regression – logistic regression – Generalized Linear Models (GLM) – Generalized Additive Model (GAM) – Decision Tree and Rules – RuleFit – Naive Bayes classifier – k-nearest neighbor.

UNIT 3 INTERPRETATION OF MODELS 9 Hrs.

Model-agnostic interpretation methods: partial dependence plot – Individual Conditional Expectation – Accumulated local effects – Feature interaction – Permutation feature importance – Anchors – Shapley Values – Shapley additive explanations (SHAP).

UNIT 4 ADVANCED MODELS 9 Hrs.

Global Surrogate and Local Surrogate (LIME) models – Counterfactual explanation – Adversarial examples – Prototypes and Criticisms – Maximum Mean Discrepancy (MMD) – Influential Instances.

UNIT 5 NN MODEL INTERPRETATION 9 Hrs.

Neural Network Interpretation: Feature visualization – Network Dissection – Pixel Attribution – Testing with Concept Activation Vectors – The future of ML and Interpretability.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Have an insight about the need and scope of interpretability in machine learning (ML)
CO2 - Understand how a complete ML model works and how every single decision was taken during model execution
CO3 - Explore how ML models access the information and perform the correlation
CO4 - Construct Surrogate models
CO5 - Analyze and interpret the neural network architectures
CO6 - Apply neural network architectures to real world classification problems.

TEXT / REFERENCE BOOKS

1. Molnar, Christoph. Interpretable machine learning. Lulu Press, 2019.
2. Hall, Patrick, and Navdeep Gill. An introduction to machine learning interpretability. O'Reilly Media, Incorporated, 2019

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3037	COMPREHENSIVE LINUX	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To emphasize the significance of server management concepts of an Enterprise Linux Operating System.
- To comprehend the importance of GIT repositories and Security vulnerability in Linux Operating System.
- To explore the cloud level services offered by Linux Operating System

UNIT 1 STARTING WITH LINUX 9 Hrs.

Understanding What Linux Is- Exploring Linux History- Understanding How Linux Differs from Other Operating Systems- Understanding How Linux Distributions Emerged- Creating the perfect Linux desktop- Lab: Ubuntu OS installation on Virtual machines- Starting with the Ubuntu Desktop Live image- Handling Ubuntu desktop- Using the Desktop- Understanding the importance of threads- Lab: Understanding Basic Desktop Application Management in Ubuntu- Adding an application launcher- Managing files and folders-- Installing and managing additional software- Lab: Knowing Advanced Desktop Application management in Ubuntu- Using tools- Lab: Configuring basic tools in Ubuntu OS- Working with shell in UBUNTU- Lab1: Getting aquatinted with different types of shell- LAB3: Basic Shell Management.

UNIT 2 GAINING ACCESS 9 Hrs.

Using the root User Account-Exploring Administrative Commands, Configuration Files, and Log Files- Using Other Administrative Accounts- Lab: Implementing privilege escalation- Using Shell Variables, expanding arithmetic expressions Expanding variables- Lab: Manipulating environmental/shell variable- Getting Information about Commands and help- Managing user accounts in UBUNTU- User Management- Lab: Managing Regular User Account-Group Management-Lab: Group Management- Moving around the file system UBUNTU- File Management- Lab: Working with basic file system- Permission Management- Lab: Working with file system permissions- Access Control Lists- Lab: Managing User and Group Permissions- Working with text files in UBUNTU.

UNIT 3 FILE MANIPULATIONS 9 Hrs.

Editing text files from shell prompt- Managing running processes- Process Management-Lab: Monitoring process activity- Writing simple shell scripts- Understanding Shell Scripts- Lab: Implementing basic shell programs- Understanding server managing in RHEL- Install the server RHEL- Lab: RHEL 8 Installation on Virtual Machine- Initial Server Configuration- Lab: Configuring and Verifying the Initial Server Settings-Remote Server Management- Lab: RHEL Remote Server management-Initial Server Configuration- Lab: Configuring and Verifying the Initial Server settings-Remote Server Management-

Lab: RHEL Remote Server management- File Transfer-Lab: Securely coping files between Servers-Log Management- Lab1: Monitoring system logs-Lab2: Recording and Managing Server Logs- Server Monitoring- Lab: Monitoring the Health of the server.

UNIT 4 MANAGING SOFTWARE IN RHEL 9 Hrs.

System software and package management- administering networking in RHEL- Lab: Examining and Configuring Network in Server- Starting and stopping services in RHEL- Lab: Managing Daemons and Services in RHEL- Configuring a web server in RHEL- Lab: Managing a Basic Webserver- Advance Webserver Management-Lab: Advance Webserver Management- Secure Webserver-Lab: Securing the Webserver Effectively- Managing disks and file systems- Lab: Making Simple Partitions- Logical Volume Management- Lab: Implementing Logical Volume Management (LVM)- Configuring Samba

server in RHEL- Lab: Deploy a samba share directory- Configuring an NFS file server in RHEL- Lab: Deploy a NFS Share export- Introducing container technology.

UNIT 5 INTRODUCTION TO GIT 9 Hrs.

Getting started with GIT and its architecture- Lab: Installing and Configuring GIT in RHEL- Remote Repositories - Lab: Exploring GIT Remote Repository- BRANCHING AND MERGING- Lab: Learning and Exploring Branches in GIT- Configuring databases in LINUX- Lab: MariaDB (MYSQL) installation and configuration in RHEL-MongoDB-Lab: MongoDB installation and configuration in RHEL- UNDERSTANDING LINUX SECURITY OS- Lab: Kali Linux Installation on Virtual Machine- Description about Different Security tools in Kali Linux-Hands-on Study on Nmap and Metasploit-Lab: Gathering information using NMAP-Metasploit-Lab: Vulnerability Management using Metasploit- Knowing LINUX as cloud workhorse- Amazon Web Service (AWS- Lab: Operating and Managing an EC2 Instance in AWS Cloud.

Max. 45 Hrs.

COURSE OUTCOMES

CO1 - Identify the need of a Linux Operating System.
CO2 - Know the process management functions of a Linux Operating System.
CO3 - Understand the need of users and group management in Linux Operating System.
CO4 - Find the significance of GIT repositories and databases.
CO5 - Recognize the essentials of file management part of a Linux Operating System.
CO6 - Gain an insight of the importance of cloud and security in Linux Operating System.

TEXT / REFERENCE BOOKS

1. "Comprehensive Linux for All ", Red Hat, 1st Edition, 2023.
2. Petersen, Richard, "Red Hat Enterprise Linux 8: Desktops and Administration, Surfing Turtle Press, 2019.
3. Colino, Miguel Perez, "Red Hat Enterprise Linux 8 Administration: Master Linux Administration Skills ", Packt Publishing, 2021.
4. Günther, Tobias, "Learn Version Control with Git: A Step-By-step Course for the Complete Beginner, Independently Published, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3421	DISTRIBUTED SYSTEMS AND SECURITY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the role of databases and database management systems in managing organizational data and information.
- To understand the techniques used for data fragmentation, replication and allocation and address issues involved.
- To Perceive the building blocks and design of information systems
- To acquire knowledge of information systems on Business operations

UNIT 1 INTRODUCTORY CONCEPTS AND DESIGN OF (DDBMS) 9 Hrs.

Data Fragmentation - Replication and allocation techniques for DDBMS - Methods for designing and implementing DDBMS - designing a distributed relational database - Architectures for DDBMS - Cluster federated – parallel databases and client server architecture - Overview of query processing.

UNIT 2 DISTRIBUTED SECURITY AND DISTRIBUTED DATABASE APPLICATION TECHNOLOGIES 9 Hrs.

Overview of security techniques - Cryptographic algorithms - Digital signatures - Distributed Concurrency Control - Serializability theory - Taxonomy of concurrency control mechanisms - Distributed deadlocks – Distributed Database Recovery - Distributed Data Security - Web data management - Database Interoperability.

UNIT 3 ADVANCED IN DISTRIBUTED SYSTEMS 9 Hrs.

Authentication in distributed systems - Protocols based on symmetric cryptosystems - Protocols based on asymmetric cryptosystems - Password-based authentication - Unstructured overlays - Chord distributed hash table - Content addressable networks (CAN) - Tapestry - Some other challenges in P2P system design – Tradeoffs between table storage and route lengths - Graph structures of complex networks - Internet graphs – Generalized random graph networks.

UNIT 4 FUNDAMENTALS OF INFORMATION SYSTEMS 9 Hrs.

Defining information – Classification of information – Presentation of information systems – Basics of Information systems – Functions of information systems – Components of Information systems- Limitations of Information systems – Information System Design.

UNIT 5 ENTERPRISE COLLOBRATION SYSTEMS 9 Hrs.

Groupware – Types of groupware – Enterprise Communication tools – Enterprise Conferencing tools – Collaborative work management tools – Information System for Business operations – transaction processing systems – functional Information Systems – Decision Support systems – Executive Information systems – Online Analytical processing.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Identify the introductory distributed database concepts and its structures.

CO2 - Produce the transaction management and query processing techniques in DDBMS.

CO3 - Develop in-depth understanding of relational databases and skills to optimize database performance.

CO4 - Critiques on each type of databases.

CO5 - Analyse, Design and present the information systems.
CO6 - Designing of decision support system and tools for Business operations.

TEXT / REFERENCE BOOKS

1. George Coulouris, Jean Dollimore, Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education Asia, 2012.
2. Ajay D. Kshemkalyani, MukeshSinghal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2008.
3. Distributed Databases - Principles and Systems; Stefano Ceri; Guiseppe Pelagatti; Tata McGraw Hill; 2006.
4. Ralph Stair and George Reynolds. , “Principles of Information Systems” Course Technology, Inc.,2006

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SECB7101	WIRELESS SENSOR NETWORK AND ARCHITECTURE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- Learn key routing protocols and transport layer protocols for sensor networks and main design issues.
- Understand the medium access control protocols and address physical layer issues.
- To learn the security features in WSN.

UNIT 1 INTRODUCTION AND OVERVIEW OF WIRELESS SENSOR NETWORKS 9 Hrs.

Introduction - Brief Historical Survey of Sensor Networks - and Background of Sensor Network Technology - Ah-Hoc Networks - Applications of Wireless Sensor Networks: Sensor and Robots - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Another Taxonomy of WSN Technology - Basic Sensor Network Architectural Elements - Home Control - Medical Applications.

UNIT 2 ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS 9 Hrs.

Designing issues - classification of routing protocols - table driven routing protocols - on demand routing protocol - Hybrid routing protocol - Hierarchical routing protocols. Multicast routing in Ad Hoc wireless networks: Operations and classification of multicast routing protocols - Tree based multicast routing protocol - Mesh based multicast routing protocol.

UNIT 3 SYSTEM ARCHITECTURE AND DESIGN ISSUES 9 Hrs.

Design Constraints for Routing in Wireless Sensor Networks - Classification of Routing Protocols in Wireless Sensor Networks-Hierarchy Role of Nodes in the Network - Data Delivery Model - Optimization Techniques for Routing in Wireless Sensor Networks - Application of the Optimization Techniques: Routing Protocols.

UNIT 4 ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS 9 Hrs.

Introduction - Data Dissemination and Gathering - Routing Challenges and Design Issues in Wireless Sensor Networks Network Scale and Time-Varying Characteristics - Resource Constraints - Sensor Applications Data Models - Routing Strategies in Wireless Sensor Networks: WSN Routing Techniques - Flooding and Its Variants - Sensor Protocols for Information via Negotiation - Low-Energy Adaptive Clustering Hierarchy - Power-Efficient Gathering in Sensor Information Systems - Directed Diffusion - Geographical Routing.

UNIT 5 TRANSPORT LAYER SECURITY PROTOCOLS FOR AD HOC WIRELESS NETWORK 9 Hrs.

Designing issues - classification of transport layer solutions - feedback based TCP - TCP bus - Ad Hoc TCP - Security in Ad hoc wireless networks - Issues and challenges in security provisioning - Key management - Secure routing in Ad hoc wireless networks. Quality of Service: Issues and challenges in providing QoS in Ad Hoc wireless networks - classification of QoS solutions.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - An Ability to understand the concepts of sensors.
CO2 - An Ability to analyse modelling and simulation of various communication networks.
CO3 - Demonstrate knowledge of MAC protocols developed for WSN.
CO4 - Demonstrate knowledge of routing protocols developed for WSN.

CO5 - Understand and explain mobile data-centric networking principles.
CO6 - An Ability to understand the security features in WSN.

TEXT / REFERENCE BOOKS

1. **I**brahiem M.M. El Emary, Ramakrishnan.S, "Wireless Sensor Networks From Theory to Applications", CRC Press,2013.
2. Fei Hu, Xiaojun Cao, "Wireless Sensor Networks Principles and Practice", CRC Press, 2010.
3. Mounir Frikha, "Ad hoc Networks Routing, Qos and Optimization", Wiley, 2011.
4. Raheem, Beyah, Janise McNair, Cherita Corbett, Security in Ad hoc and Sensor Networks", World Scientific, 2010.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3554	DATA MINING AND PREDICTIVE MODELING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn, how to develop models to predict categorical and continuous outcomes
- To learn techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
- To know the use of the binary classifier and numeric predictor nodes to automate model selection.
- To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

UNIT 1 INTRODUCTION TO DATA MINING 9 Hrs.

Introduction, what is Data Mining? Concepts of Data mining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on various kinds of data, Applications of Data Mining, Challenges of Data Mining.

UNIT 2 DATA UNDERSTANDING AND PREPARATION 9 Hrs.

Introduction, Reading data from various sources, Data visualization, Distributions and summary statistics, Relationships among variables, Extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation, Combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, Missing Values.

UNIT 3 MODEL DEVELOPMENT AND TECHNIQUES 9 Hrs.

Data Partitioning, Model selection, Model Development Techniques, Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine, Bayesian Networks, Linear Regression, Cox Regression, Association rules.

UNIT 4 MODEL EVALUATION AND DEPLOYMENT 9 Hrs.

Introduction, Model Validation, Rule Induction Using CHAID, Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, Meta Level Modeling, Deploying Model, Assessing Model Performance, Updating a Model.

UNIT 5 PREDICTION METHODS 9 Hrs.

Linear Regression: Best Subset Selection-Forward Selection, Backward Selection, Step-wise Regression, All Subsets Regression, Penalized Regression Methods-Ridge, LASSO, Adaptive LASSO, and Elastic Net, k-Nearest Neighbors, Regression Trees- CART, CHAID, Neural Nets.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Able to understand the data mining concepts.
CO2 - Understand the process of formulating business objectives, data selection/collection
CO3 - Able to design, build, evaluate and implement predictive models for a various business application.
CO4 - Compare the underlying predictive modeling techniques.
CO5 - Select appropriate predictive modeling approaches to identify cases to progress with.
CO6 - Apply predictive modeling approaches using a suitable package such as SPSS Modeler

TEXT / REFERENCE BOOKS

1. Predictive & Advanced Analytics, 2017 (IBM ICE Publication)
2. Data Mining Methods and Models, Daniel T. Larose,2006.
3. Data Mining for Business Intelligence by GalitShmueli, Nitin R. Patel, and Peter C. Bruce, Wiley, 3rd ed., 2016
4. Data Mining and Predictive Analytics, Daniel T. Larose, 2015
5. Predictive Analytics and Data Mining: Concepts and Practice with RapidMiner, Bala Deshpande, Vijay Kotu,2014

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3515	SMART SENSING STRUCTURES AND AI	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To Learn basics of Smart Sensor and Micromachining technology.
- Learn online tools for evaluating sensor design issues.
- Learn layer protocols for smart sensor networks, and design requirements.
- Understand the wireless sensing protocols.
- To learn the different sensor structures used in AI

UNIT 1 SMART SENSOR BASICS 9 Hrs.

Nature of Sensors, Integration of Micromachining and Microelectronics, Micromachining- Bulk Micromachining, Wafer Bonding, Surface Micromachining, The LIGA Process- Dry Etching Processes – Micromilling-Lasers in Micromachining. MEMS- software tools.

UNIT 2 SENSOR OUTPUT CHARACTERISTICS 9 Hrs.

Sensing Technologies, Digital Output Sensors, Noise/Interference Aspects, Sensitivity Improvement, Amplification and Signal Conditioning - s Integrated Signal Conditioning- Digital Conversion- On-Line Tool for Evaluating a Sensor Interface Design.

UNIT 3 COMMUNICATIONS FOR SMART SENSORS 9 Hrs.

Communications for Smart Sensors: Standards, Automotive Protocols, Industrial Networks, Protocols in Silicon, Transitioning Between Protocols - Control Techniques- State Machines, Fuzzy Logic, Neural Networks, Adaptive Control, RISC Versus CISC, Impact of Artificial Intelligence.

UNIT 4 WIRELESS SENSING 9 Hrs.

Wireless Data and Communications- Wireless Sensing Networks- Industrial Wireless Sensing Networks- RF Sensing- Telemetry- RF MEMS- Application Example, MEMS- Actuators, Micromachined Structures, Packaging, Testing, and Reliability Implications of Smarter Sensors.

UNIT 5 APPLICATIONS OF AI 9 Hrs.

Automotive Applications, Industrial (Robotic) Applications, Consumer Applications, Structural Health Monitoring, Building Automations Systems, Automotive, aircraft, portable consumer, Automated Medical Image Analysis in Digital Mammography, Lung Cancer Detection and Diagnosis based on Deep Learning Models Evaluation.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - An Ability to understand the concepts of smart sensors.
CO2 - An Ability to evaluate the sensor design.
CO3 - Demonstrate knowledge of wireless sensor protocols
CO4 - Demonstrate knowledge of routing protocols developed for WSN.
CO5 - Understand and explain the smart sensor with AI principles.
CO6 - An Ability to implement the smart sensor in AI applications.

TEXT / REFERENCE BOOKS

1. Understanding smart sensors, Randy Frank, 2018
2. Artificial Intelligence and Internet of Things, Lalit Mohan Goyal, Tanzila Saba, Amjad Rehman, SouadLarabi-Marie-Sainte, 2021

3. Life 3.0, Max Tegmark, 2017
4. Smart Sensors and Devices in Artificial Intelligence, Xuechao Duan, Dan Zhang,2021.
5. Smart Sensors and Systems, HirotoYasuura, Yongpan Liu, Chong-Min Kyung,2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3422	KNOWLEDGE MANAGEMENT SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study the basic rudiments of knowledge management.
- To acquire the Knowledge Capturing Techniques and learn coding tools and procedures
- To explore the faster decision making with knowledge transfer systems.

UNIT1 KNOWLEDGE MANAGEMENT 9 Hrs.

KM Myths–KM Life Cycle–Understanding Knowledge–Knowledge, intelligence –Experience – Common Sense – Cognition and KM – Types of Knowledge – Expert Knowledge – Human Thinking and Learning.

UNIT 2 KNOWLEDGE MANAGEMENTSYSTEM LIFE CYCLE 9 Hrs.

Challenges in Building KM Systems– Conventional Vrs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture.

UNIT 3 CAPTURING KNOWLEDGE 9 Hrs.

Evaluating the Expert – Developing a Relationship with Experts – Fuzzy Reasoning and the Quality of Knowledge – Knowledge Capturing Techniques, Brain Storming – Protocol Analysis – ConsensusDecisionMaking–RepertoryGrid-ConceptMapping–Blackboarding.

UNIT 4 KNOWLEDGE CODIFICATION 9 Hrs.

Modes of Knowledge Conversion – Codification Tools and Procedures –Knowledge Developer's Skill Sets – System Testing and Deployment – Knowledge Testing –Approaches to Logical Testing, UserAcceptanceTesting–KMSystemDeploymentIssues–UserTraining–Postimplementation.

UNIT 5 KNOWLEDGE TRANSFER AND SHARING 9 Hrs.

Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the concept of knowledge and its types
CO2 - Analyze the challenges in building Knowledge Management systems
CO3 - Develop knowledge management capturing techniques
CO4 - Test the coding tools for knowledge management systems.
CO5 - Understand the architecture and development of knowledge systems
CO6 - Develop models with Knowledge management system tools

TEXT / REFERENCEBOOKS

1. Elias.M.Award, Hassan M.Ghaziri, "Knowledge Management" , Pearson Education, 2007.
2. Becerra-Fernandez, Irma., Sabherwal, Rajiv. Knowledge Management: Systems and Processes. United Kingdom: Taylor & Francis, 2014.
3. Husain, Shabahat., Ermine, Jean-Louis, "Knowledge Management Systems: Concepts, Technologies and Practices", Emerald Publishing Limited, 2021.

4. C.W.Holsapple, “Handbooks on Knowledge Management”, Springer Berlin Heidelberg, 2013.
5. Becerra-Fernandez, I.Sabherwal, R., “Knowledge Management: Systems and Processes”, M.E.SharpeInc., 2010.

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END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3611	APPLICATIONS OF AI	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To examine different interactive and intelligent real-time applications in medicine field.
- To implement real world AI applications in computer engineering.
- To applying AI state of art techniques for IoT based applications.
- To explore trending applications in the domain of artificial intelligence and machine learning.

UNIT 1 GENERAL PURPOSE APPLICATIONS 9 Hrs.

Classification techniques under Supervised Learning – Dimensionality Reduction – Data Visualization – Recommender system technology – Knowledge modeling – Information retrieval – Ontology management – E-Commerce system.

UNIT 2 INTERACTIVE AND INTELLIGENT APPLICATIONS 9 Hrs.

High level activity detection in video – Collaborative filtering approach – Medical Image Processing in wavelet domain – Ulcer Lesion Diagnosis using AI – State of art techniques in Skin Cancer Diagnosis – Fuzzy systems in Biomedicine – Gene expression interpretation.

UNIT 3 REAL WORLD COMPUTER ENGINEERING APPLICATIONS 9 Hrs.

Classifier ensemble approach for Intrusion Detection – Indoor Smart Antenna system – Interpretation of cross media content – Video watermarking and benchmarking – State of art techniques in Face Detection and recognition systems – Tracking system – Robotic Sensor Networks.

UNIT 4 IOT BASED APPLICATIONS 9 Hrs.

Bacteria Foraging Optimization for graphical routing in IoT – ZigBee protocol Security in IoT – State of art techniques of AI for applications in IoT – IoT based runaway syndrome tracking system – IoT based smart wheelchair for type-2 diabetes and spine- disorder patients – Spade to Spoon IoT based ML approach for Precision Agriculture.

UNIT 5 OTHER TRENDING APPLICATIONS 9 Hrs.

NLP: Single-Sentence, Similarity and paraphrase and Inference task – Literature Mining: Indexing and Retrieval – Knowledge graph representation – Misinformation detection – Public Sentiment Analysis – Medical Image Analysis – Ambient Intelligence – Vision-based robotics – Precision Diagnostics – Protein structure prediction – Drug Repurposing

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Learn general purpose application that uses Artificial Intelligence.
CO2 - Examine different interactive and intelligent applications in AI.
CO3 - Implement real world AI applications in computer engineering.
CO4 - Apply AI techniques for IoT based applications.
CO5 - Design trending applications in the domain of artificial intelligence.
CO6 - Develop applications for real time societal needs.

TEXT / REFERENCE BOOKS

1. Xiao-Zhi Gao, Rajesh Kumar, SumitSrinivastava, Bhanu Pratap Soni Applications of Artificial Intelligence in Engineering: Proceedings of First Global Conference on Artificial Intelligence and Applications (GCAIA 2020)

2. Ilias G. Maglogiannis, Emerging Artificial Intelligence Applications in Computer Engineering: Real Word AI Systems with Applications in eHealth, HCI, Information Retrieval and ... in Artificial Intelligence and Applications)

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3431	ARTIFICIAL NEURAL NETWORKS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand basics of artificial neural networks.
- To explore different forms of neural networks
- To analyze the strengths and limitations of Neural Networks.

UNIT 1 INTRODUCTION TO ANN 9 Hrs.

Artificial Neural Networks (ANN) and their biological roots and motivations. ANNs as numerical data/signal/image processing devices- summing dendrite, synapses and their weights, pre- and postsynaptic signals, activation potential and activation function. Excitatory and inhibitory synapses. The biasing input. Types of activating functions. Encoding (training phase) and decoding (active phase). Taxonomy of neural networks: -feedforward and recurrent networks with supervised and unsupervised learning laws, static &dynamic processing systems, basic data structures: mapping of vector spaces, clusters, principal components.

UNIT 2 LINEAR AND FEEDFORWARD NETWORKS 9 Hrs.

Linear Networks:-Adaline - the adaptive linear element, Linear regression. The Wiener-Hopf equation. The Least-Mean-Square (Widrow-Hoff) learning algorithm. Method of steepest descent. Adaline as a linear adaptive filter. A sequential regression algorithm. Multi-Layer Feedforward Neural Networks:- Multi-Layer Perceptron's. Supervised Learning. Approximation and interpolation of function. Back-Propagation Learning law. Fast training algorithms. Applications of multilayer perceptron's: Image coding, Paint-quality inspection, Nettalk.

UNIT 3 SOM 9 Hrs.

Self-Organizing Systems:-Unsupervised Learning, Pattern clustering , Topological mapping , Kohonen's self-organizing map , Local learning laws-Generalized Hebbian Algorithm. The Oja's and Sanger's rules. Principal component analysis - Karhunen-Loeve transform.

UNIT 4 NEURAL NETWORKS 9 Hrs.

Feedback neural networks:- Pattern storage and retrieval, Hopfield model, Boltzmann machine, Recurrent neural networks.

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UNIT 5 RADIAL BASIS FUNCTION 9 Hrs.

Radial basis function networks:- Regularization theory, RBF networks for function approximation, RBF networks for pattern classification.

Kernel methods for pattern analysis:- Statistical learning theory, Relevance vector machines for classification and regression.

Max. 45 Hrs.

COURSEOUTCOMES

On completion of the course the student will be able to

CO1 - Understand the basic principles of Artificial Neural Networks
CO2 - Apply different types of ANNs to various problems
CO3 - Implement ANN models using appropriate tools and libraries
CO4 - Train and optimize ANN models effectively.
CO5 - Evaluate and interpret ANN model results.
CO6 - Develop models to critically analyze and utilize them to solve real world problems,

TEXT / REFERENCE BOOKS

1. B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India,1905.
2. Satish Kumar, Neural Networks – A Classroom Approach, Tata McGraw-Hill,2009.
3. S.Haykin, Neural Networks – A Comprehensive Foundation, Prentice Hall,1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3613	AI IN SPEECH PROCESSING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand acoustic theory behind the human speech production and perception systems.
- To analyze and estimate the acoustic features from a speech signal
- To implement AI based algorithms used for speech modeling and speech systems
- To develop applications for text to speech conversion.

UNIT 1 SPEECH PROCESSING BASICS 9 Hrs.

Basic Concepts: Speech Fundamentals: Articulatory Phonetics–Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

UNIT 2 SPEECH Analysis 9 Hrs.

Speech Analysis: Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.

UNIT 3 SPEECH MODELS 9 Hrs.

Speech Modeling: Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.

UNIT 4 SPEECH Recognition 9 Hrs.

Speech Recognition: Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n- grams, context dependent sub-word units; Applications and present status.

UNIT 5 SPEECH synthesis 9 Hrs.

Speech Synthesis: Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and present status.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Infer knowledge about acoustics of speech production and perception
CO2 - Analyzing efficient speech features used for modeling
CO3 - Evaluate different Speech modeling mechanism
CO4 - Design algorithms on AI based Speech modeling
CO5 - Compare various speech synthesis methods
CO6 - Develop real time application based on speech to text conversion

TEXT / REFERENCE BOOKS

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language
2. Processing, Computational Linguistics, and Speech Recognition”, Pearson Education. 2008
3. Speech and Language Processing (3rd edition),Dan Jurafsky and James H. Martin, October 16, 2019

4. Lawrence RabinerandBiing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education,2008.
5. Steven W. Smith, “The Scientist and Engineer’s GuidetoDigitalSignalProcessing”, California Technical Publishing. 2011
6. Thomas FQuatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education.2002
7. Claudio BecchettiandLucioPrinaRicotti, “Speech Recognition”, John Wiley and Sons, 1999.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3614	INTELLIGENT EMBEDDED SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To design an Embedded system using various methodologies
- To build process for an embedded system.
- To understand Embedded system principles and programming concepts
- To infer the concepts of microcontroller-based system integration and interfacing with ARM architecture

UNIT 1 EMBEDDED SYSTEM BASICS 9 Hrs.

Introduction to Embedded systems, Characteristics and quality attributes (Design Metric) of embedded system, hardware/software co-design, Embedded micro controller cores, embedded memories, Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, and UML.

UNIT 2 EMBEDDED SYSTEM DESIGN REQUIREMENTS 9 Hrs.

Embedded C-programming concepts, Basic embedded C programs/applications for ARM-v7, Interfacing and Integration of microcontroller-based systems, communication protocols like SPI, SCI (RS232, RS485), I2C, CAN, USB (v2.0), fundamentals of wireless networks for embedded system - Bluetooth, Zig-Bee. Examples of Industrial process automation, software development using python, Introduction to Linux OS, Rapid prototyping using low-cost hardware (STM32 discovery board, Raspberry Pi)

UNIT 3 EMBEDDED SOFTWARE DESIGN 9 Hrs.

Embedded software, Embedded system architectures: state of the art and practice, Typical System on Chip (SOC) components., SOC architectures, Embedded system's Codesign methodologies: state of the art and practice, Aspect-oriented Codesign, Model-driven Codesign, Web-based Codesign, Cloud Codesign, FCodesign: formal Codesign, PCodesign: prototypic Codesign.

UNIT 4 INTELLIGENT EMBEDDED SOFTWARE DESIGN FLOW 9 Hrs.

Conventional Codesign flow, Embedded software synthesis flow. IP-based Codesign, Platform-based Codesign, Design pattern- based Codesign, IDE-based Codesign, Codesign for reuse, Conventional Codesign flow, Embedded software synthesis flow. IP- based Codesign, Platform-based Codesign, Design pattern-based Codesign, IDE-based Codesign, Codesign for reuse.

UNIT 5 INTELLIGENT EMBEDDED SYSTEMS 9 Hrs.

Intelligent embedded systems, Intelligent embedded system features, intelligent embedded software, Adaptable embedded software flow, application of AI in the field of ES Codesign, Expert systems, neural networks and fuzzy logic, Multiagent systems, Ontologies, Nature/bioinspired approaches Constraint satisfaction, Logic programming, Hybrid models, Organic computing, generic OC system architecture. IA-based Codesign flow for intelligent embedded systems, Embedded computing vs. intelligent computing, IA-based IES Co-design, Challenges and perspectives.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the terminologies and characteristics of basic embedded systems
CO2 - Apply modeling and programming concepts for embedded product development
CO3 - Examine different interfacing techniques to communication with embedded hardware
CO4 - Investigate case studies in industrial embedded systems

CO5 - Create an intelligent embedded system for Industrial applications
CO6 - Apply embedded system solution to real world problems.

TEXT / REFERENCE BOOKS

1. Jonathan Valvano, "Embedded Systems: Introduction to ARM® Cortex™-M Microcontrollers", Fourth Edition, Create Space Publishing, 2013.
2. Fateh Boutekkouk, RidhaMahalaine, Zina Mecibah, SalihaLakhdari, RamissaDjouani and DjalilaBelkebir, Intelligent
3. Embedded Software: New Perspectives and Challenges.
4. K.V. Shibu, "Introduction to Embedded Systems", McGraw Hill Education, 2009
5. Edward A. Lee, and Sanjit A. Seshia, "Introduction to Embedded Systems- A Cyber Physical Systems Approach", Second Edition, 2015.
6. Jeff C. Jensen, Edward A. Lee, and Sanjit A. Seshia, "An Introductory Lab in Embedded and Cyber-Physical Systems", First sysEdition, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3615	INTRODUCTION TO VIRTUAL REALITY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To infer the principles and multidisciplinary features in virtual reality.
- To explore the technology for multimodal user interaction and perception in VR.
- To implement technology for managing large scale VR environment in real time.
- To develop VR system framework and applications.

UNIT 1 INTRODUCTION OF VIRTUAL REALITY 9 Hrs.

Fundamental Concept and Components of Virtual Reality- Primary Features and Present Development on Virtual Reality – VR systems - VR as a discipline-Basic features of VR systems-Architecture of VR systems-VR hardware -VR input hardware: tracking systems, motion capture systems, data gloves-VR output hardware: visual displays.

UNIT 2 I/O INTERFACE AND TECHNIQUES IN VR 9 Hrs.

Multiple Modals of Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual / Auditory / Haptic Devices. Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3DManus, Object Grasp.

UNIT 3 VISUAL COMPUTATION IN VIRTUAL REALITY 9 Hrs.

Fundamentals of Computer Graphics-Software and Hardware Technology on Stereoscopic Display-Advanced Techniques in CG: Management of Large-Scale Environments & Real Time Rendering - Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development ToolsinVR.X3DStandard; Vega, MultiGen, Virtoolsetc.

UNIT 4 DECODING HARDWARE: METRICS AND DISPLAY 9 Hrs.

Metrics: update rate – refresh rate – latency hardware devices: PC – Supercomputer – workstation – Motion Tracking: Mechanical – Optical – Ultrasonic – Electromagnetic – Active Infrared – Inertial – Input type : Manual operation and Automatic tracking Input Devices: 3D Mouse – Gloves – Trackpads – Body suits – Joystick – Tracking Balls – Output devices: Force Feedback Sensors – Haptic interface – Glasses: Shutter glasses – Display: 3D Screen – HMD – BOOM – Retinal Displays – Panoramic Screen – Virtual Table – CAVE.

UNIT 5 APPLICATION OF VR IN DIGITAL ENTERTAINMENT 9 Hrs.

VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.3D user interfaces - Why 3D user interfaces. Major user tasks in VE. Interaction techniques for selection, manipulation and navigation.3DUIevaluation.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Design VR system.
CO2 - Apply visual computation in a virtual environment.
CO3 - Analyze and design the framework in VR using various software development tools in VR.
CO4 - Develop multi modal user interface.
CO5 - Describe the principles and features of VR.
CO6 - Recognize the technologies used to manage the large-scale VR environment in real time.

TEXT / REFERENCE BOOKS

1. Sherman, WilliamR.and Alan B.Craig. Understanding Virtual Reality Interface, Application and Design, Morgan Kaufmann, 2002.
2. Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
3. Guangran LIU. Virtual Reality Technology,Tsinghua Press,Jan.2011.
4. Burdea, G.C.and P.Coffet. Virtual RealityTechnology,Second Edition. Wiley-EEPress,2003/2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3616	SOFT COMPUTING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the knowledge about Genetic Algorithms and design neural networks.
- To implement the concepts of neuro fuzzy.
- To develop applications implementing Fuzzy Logic.

UNIT 1 NEURAL NETWORKS 9 Hrs.

Introduction to ANS - Adaline - Back propagation network - Hopfield network - Boltzmann machine - Self organizing maps Support Vector Machines- Spike Neuron Models.

UNIT 2 FUZZY LOGIC 9 Hrs.

Fuzzy sets - Fuzzy rules and fuzzy reasoning –Defuzzification- Fuzzy inference system - Mamdani fuzzy model - Sugenofuzzy model - Tsukamoto fuzzy model

UNIT 3 NEURO FUZZY 9 Hrs.

Adaptive Neuro Fuzzy Inference System - Coactive neuro-fuzzy modelling - Classification and regression trees - Data Clustering Algorithm - Rule based structure - Neuro - Fuzzy control I - Neuro - Fuzzy control II - Fuzzy decision making.

UNIT 4 GENETIC ALGORITHM 9 Hrs.

Introduction - Implementation of GA - Reproduction - Crossover - Mutation - Coding - Fitness scaling - Application of GA.

UNIT 5 ARTIFICIAL INTELLIGENCE 9 Hrs.

Introduction - Searching techniques - First order Logic - Forward reasoning - Backward reasoning - Semantic – Frames.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Describe human intelligence and how intelligent system works.
CO2 - Apply basics of Fuzzy logic and neural networks.
CO3 - Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
CO4 - Discuss about Neuro Fuzzy concepts.
CO5 - Develop genetic algorithms and other random search procedures with global optimum in self-learning situations.
CO6 - Address current research problems and research methods in Soft Computing Techniques.

TEXT / REFERENCE BOOKS

1. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.
2. S.R. Jang, C.T. Sun and E. Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education 2004.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. Stuart J. Russel, Peter Norvig, “Artificial Intelligence a Modern Approach”, 2nd Edition, Pearson Education, 2003.
5. S.N. Sivanandam, S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011.

6. S. Rajasekaran, G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications “, PHI Learning Pvt. Ltd., 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3711	ML TOOLS AND TECHNIQUES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand input preprocessing and combining output from different methods.
- To provide data analytic skills by processing and visualization of data.
- To analyze performance improvement techniques.
- To design and develop engineering applications.

UNIT 1 INTRODUCTION TO DATA MINING AND MACHINE LANGUAGE 9 Hrs.

Fielded Applications, The Data Mining Process, Machine Learning and Statistics, Generalization as Search, Data Mining and Ethics, Input: concepts, instances, attributes, Preparing the Input, output: Knowledge representation- Tables, Linear Models, Trees, Rules, Instance-Based Representation, Clusters.

UNIT 2 KNOWLEDGE REPRESENTATION 9 Hrs.

Tables, Linear Models, Trees, Rules, Instance-Based Representation, Clusters, and Algorithms: the basic Methods, Inferring Rudimentary Rules, Simple Probabilistic Modeling, Divide-and-Conquer: Constructing Decision Trees, Covering Algorithms: Constructing Rules, Mining Association Rules, Linear Models, Instance-Based Learning, Clustering, Multi-Instance Learning.

UNIT 3 CREDIBILITY 9 Hrs.

Training and Testing, Predicting Performance, Cross-Validation, Other Estimates, Hyperparameter Selection, Comparing Data Mining Schemes Predicting Probabilities, Counting the Cost, Evaluating Numeric Prediction, The Minimum Description Length Principle, Applying MDL to Clustering, using a Validation Set for Model Selection.

UNIT 4 TREES AND RULES 9 Hrs.

Decision Trees, Classification Rules, Association Rules, extending instance-based and linear models- Instance-Based Learning, Extending Linear Models, Numeric Prediction with Local Linear Models, WEKA Implementations. Data transformations- Attribute Selection, Discretizing Numeric Attributes, Projections, Sampling, Cleansing, Transforming Multiple Classes to Binary Ones, Calibrating Class Probabilities.

UNIT 5 MACHINE LEARNING TOOLS 9 Hrs.

Knime, Accord. net, Scikit- Learn, Tensor Flow, Pytorch, Rapid Miner, Google Cloud AutoML, Jupyter Notebook, Apache Mahout, Azure Machine Learning studio, MLLIB, Orange3, IBM Watson, Pylearn2.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Represent the knowledge using tools
CO2 - Compare different output models and their applications
CO3 - Analyze on how to improve the performance
CO4 - Design different models using WEKA tools
CO5 - Work with learning workbench and links to algorithm implementations in the software.
CO6 - Implement applications with ML Tools.

TEXT / REFERENCE BOOKS

1. Data mining machine learning tools and techniques, Chris Pal, Ian Witten, Eibe Frank, Mark Hall, 2011.
2. Machine Learning the art of science and algorithms that make sense of data, peter, flach,2012.
3. Machine Learning for Absolute Beginners, Oliver Theobald,2021.
4. Interpretable Machine Learning, Christoph Molnar,2020.
5. Data Mining: Practical Machine Learning Tools and Techniques, Ian H. Witten, Eibe Frank, Mark A. Hall,2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3712	SECURITY IN AI	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand Artificial Intelligence (AI) and Machine Learning (ML) tools to enhance security
- To prevent various Malwares and Bot attacks using sophisticated AI and ML techniques
- To develop applications with firewalls.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction – Understanding AI and ML – Automation – Limitations of Rules-based, Signature-based and Firewall solutions – Challenges in adopting AI and ML for security.

UNIT 2 THREATS AND CHALLENGES 9 Hrs.

Focusing on the Threat of Malicious Bots – Bots and Botnets – Remote Code Execution – Flexible Malicious Bots – Evolution Botnet – Bot Marketplace – AI and ML Adoption in Botnets.

UNIT 3 ANOMALIES DETECTION 9 Hrs.

AI and ML on the security front – Finding Anomalies – ML for Bot attack remediation – Supervised ML defenses for security events and log analysis – Malware detection – Identify Bots using AI.

UNIT 4 INSIDER THREAT TRACKING 9 Hrs.

Insider threat identification – Tracking Attacker Dwell Time – Orchestrating Protection – ML and AI in current Security Solutions.

UNIT 5 FIREWALLS 9 Hrs.

Managed Security Service Providers – MSSP in AI and ML Source – Cloud-Based Web Application Firewalls using AI and ML – Study: Global Media Company Fights Scraping Bots.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Address insights into the main security methods used in artificial intelligence (AI) and machine learning (ML)
CO2 - Understand the importance of AI and ML in security.
CO3 - Apply AI and ML techniques to solves cyber-attacks.
CO4 - Adversaries benefit and challenges in using AI and ML.
CO5 - Design Security with Managed Security Service Providers.
CO6 - Develop security solutions to Real time problems.

TEXT / REFERENCE BOOKS

1. Gil, Laurent, and Allan Liska. Security with AI and Machine Learning. O'Reilly Media, Incorporated, 2019.
2. Taimur Ijlal, Artificial Intelligence (AI) Governance and Cyber-Security: A beginner's handbook on securing and governing AI systems, ISBN-13,979-8806138355, 2022.
3. Alessandro Parisi, "Hands-On Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventing cyber-attacks and detecting threats and network anomalies" Packt Publishing Limited, 2019.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3713	DIGITAL IMAGE PROCESSING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To develop a theoretical foundation of image processing techniques.
- To implement color image processing, image compression, image segmentation and representation
- To develop analytic skills to process the images

UNIT 1 INTRODUCTION 9 Hrs.

Image Representation, Components of Digital Image Processing Systems, Image Sensing and Acquisition, Elements of Visual Perception, Image formation model, Image Sampling and Quantization, Relationship between pixels.

UNIT 2 IMAGE ENHANCEMENT 9 Hrs.

Enhancement by Point Processing, Histogram Processing, Arithmetic/Logic Operations, Image Averaging, Spatial Filters for Smoothing and Sharpening, Frequency domain filters for Smoothing and Sharpening; Image Degradation & Restoration Model, Noise Models, Inverse Filtering, Geometric Mean Filter.

UNIT 3 IMAGE SEGMENTATION 9 Hrs.

Detection of Discontinuities, Edge Linking and boundary Detection, Thresholding, Region based Segmentation, Coding Redundancy, Inter pixel Redundancy, Image Compression model, Error Free Compression, Variable Length Coding, Lossy Compression

UNIT 4 MORPHOLOGICAL AND COLOUR IMAGE PROCESSING 9 Hrs.

Dilation and Erosion, Opening and Closing, Basic Morphological Algorithms: Boundary Extraction, Region Filling, Thickening and Thinning; Colour Image Representation, Colour Models, Pseudo Colour Image Processing, Colour Transformations, Smoothing and Sharpening, Segmentation based on Colour.

UNIT 5 MEDICAL IMAGE PROCESSING 9 Hrs.

Noise Reduction in Nuclear Medicine Imaging, Contrast enhancement of mammograms, Detection of Spinal Canal, Detection of calcifications by multi-tolerance region growing, Shape analysis of calcifications, Analysis of Ligament Healing.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the fundamentals of Digital Image Processing.
CO2 - Learn the image enhancement techniques in Spatial and Frequency Domain
CO3 - Model the Noises, Restoration and Compression.
CO4 - Analyze segmentation and compression techniques.
CO5 - Design algorithms for Color Image Processing.
CO6 - Apply algorithms for Medical Image Processing.

TEXT / REFERENCE BOOKS

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", 4th Edition, Pearson Education, 2017.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing Analysis and Machine Vision", 4th Edition, Cengage Learning, 4th Edition, 2014.

3. B. Chanda, D. Dutta Majumdar, "Digital Image Processing and Applications", Prentice Hall of India, 2011.
4. William K Pratt, "Digital Image Processing", 4th Edition, John Willey 2007.
5. 5 Rangaraj M. Rangayyan, “Biomedical Image Analysis”, CRC Press LLC, Boca Raton, FL, 2005
6. Jain A.K., "Fundamentals of Digital Image Processing", Pearson Education, 1989

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3017	CYBER DIGITAL TWIN	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To identify types of digital twin and data IoT technologies
- To understand twin Modeling and design Modeling, Risk Management and Twin Constructions
- To address security concerns while implementing Cyber Digital Twin Technology

UNIT 1 INTRODUCTION 9 Hrs.

Introduction- Cyber Digital twin-definition-uses and benefits-need for digital twin-working principle Technology Digital thread- digital shadow-building blocks of digital twin-digital twin technology drivers and enablers.

UNIT 2 DATA MODELING ENVIRONMENT 9 Hrs.

Types of digital twin-Based on Product and Process-Based on Functionality-Based on Maturity. Development considerations- Overview of Data-Modeling Environment. Modelling-model and data management-Managing data-implementing the model- Cloud and IOT technologies.

UNIT 3 DIGITAL TWIN OPTMIZATION 9 Hrs.

Cyber range vs digital twin-human behavior modeling in digital twin-optimization using digital twin-digital twin and cyber security- Techniques. Technologies-Industrial IOT and Digital Twin-simulation and digital twin-Machine learning and digital twin-virtual reality and digital twin-cloud technology and digital twin.

UNIT 4 RISK MANAGEMENT 9 Hrs.

Digital twin and Risk Assessment-Digital twin reference model-Implementation-Development of risk assessment plan- Development of communication and control system-Development of digital twin tools-Integration-platform validation-Difficulties- Practical implications.

UNIT 5 APPLICATIONS 9 Hrs.

Applications: Digital Twin in Manufacturing-Digital Twin in Automotive-Digital Twin in Healthcare-Digital Twin in Utilities-Digital Twin in Construction-Digital Twin in Education-Digital Twin in Medicine.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Implement fundamental Cyber System and Digital Twin Technology
CO2 - Understand types and data modeling of Digital twin
CO3 - Address optimization, simulation and validation
CO4 - Know about the risk and Control development
CO5 - Design application in different fields with cyber system.
CO6 - Develop applications using Cyber digital Twin Technologies

TEXT / REFERENCE BOOKS

1. Cyber-physical System and Digital Twins - Michael E. Auer Kalyan Ram B. Digital - Part of the Lecture Notes in Networks and Systems book series
2. Development and Deployment on the Cloud – Nassim Khaed, BibinPattel and Affan Siddiqui – Elsevier 2020.
3. Hacking Exposed Industrial Control Systems: ICS and SCADA Security Secrets & Solutions (1st Edition), by Clint Bodungen, Bryan Singer, Aaron Shbeeb, Kyle Wilhoit, and Stephen Hilt, ISBN:

978-1259589713.

4. Applied Cyber Security and the Smart Grid: Implementing Security Controls into the Modern Power Infrastructure (1st Edition), by Eric D. Knapp and Raj Samani The Art of Invisibility - Kevin Mitnick,2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3441	AI AND ETHICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To study about AI standards and Regulations
- To address about social and ethical issues of Robot Ethics
- To implement AI and Ethics - challenges and opportunities

UNIT 1 INTRODUCTION 9 Hrs.

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT 2 ETHICAL INITIATIVES IN AI 9 Hrs.

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles, Warfare and weaponization.

UNIT 3 AI STANDARDS AND REGULATION 9 Hrs.

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations -Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT 4 ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS 9 Hrs.

Robot-Robo ethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology – Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility Robo ethics Taxonomy.

UNIT 5 AI AND ETHICS- CHALLENGES AND OPPORTUNITIES 9 Hrs.

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-Human-AI collaboration: Understanding the roles and responsibilities of humans and AI systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1 - Learn about morality and ethics in AI
CO2 - Acquire the knowledge of real time application ethics, issues and its challenges.
CO3 - Understand the ethical harms and ethical initiatives in AI
CO4 - Brief AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
CO5 - Design concepts of Robo ethics and Morality with professional responsibilities.
CO6 - Explore about the societal issues in AI with National and International Strategies on AI

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 Exam Duration: 3 Hrs.

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3716	OPEN-SOURCE SYSTEMS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand open source licenses and learn the implications for users, developers and the software community.
- To become familiar with and become adapt using the tools of open source development.
- To learn GNU and practice open source programming techniques.

UNIT 1 OVERVIEW OF FREE/OPEN SOURCE SOFTWARE 9 Hrs.

Overview of Free/Open Source Software - Definition of FOSS & GNU - History of GNU/Linux and the free software movement -Advantages of free software and GNU/Linux –Licensing - Types of licensing, Intellectual Proprietary Right, Commercial License vs. Open source license- Open Source Licensing, Contract and Copyright Law: Basic principles of copyright law, contract and copyright, open source software licensing, Issues with copyrights and patents, warranties. The FOSS Philosophy, usage - Trends and potential -global and Indian –. FOSS Licenses – GPL- AGPL- LGPL – FDL – Implications – FOSS examples. Review of common programming practices and guidelines for GNU/Linux and FOSS.

UNIT 2 LINUX 9 Hrs.

Linux OS Installation and Hardware Configuration - Configure disk partitions & file systems and install a GNU/Linux distribution -Basic shell commands - Logging in, Listing files, editing files, copying/moving files, viewing file contents, changing file modes and permissions, process management User and group management -File ownerships and permissions -PAM authentication -Introduction to common system configuration files & log files -Configuring networking -Basics of TCP/IP networking and routing - Connecting to the Internet ,System Administration – Backup and Restore Procedures- Strategies for keeping a Secure Server.

UNIT 3 OPEN SOURCE TOOLS AND TECHNOLOGIES FOR HARDWARE AND E-MAIL SERVER 9 Hrs.

Configuring additional hardware -Sound cards -Displays & display cards-Network cards-Modems -USB drives -CD writers The OS boot up process -Performing everyday tasks using GNU /Linux - Accessing the Internet -Playing music -Editing documents and spreadsheets -Sending and receiving email -Copy files from disks and over the network -Playing games - Writing CDs -X Window system configuration and utilities -Configure X windows -Detect display devices -Installing software From source code as well as using binary packages -Setting up email servers-Using postfix -(SMTP services) -Courier (IMAP & POP3 services) -Squirrel mail (web mail services) -Setting up web servers -Using apache (HTTP services) -PHP (server-side scripting) -Perl (CGI support) -Setting up file services -Using samba (file and authentication services for windows networks) –Using NFS (file services for gnu/Linux / Unix networks) -Setting up proxy services -Using squid (http / ftp / https proxy services) – Printer Installation.

UNIT 4 UNDERSTANDING GNU LIBC LIBRARIES, COMPILERS AND LINKER 9 Hrs.

GNU compiler tools - The C compiler (gcc) and the C++ compiler (g++) - Linking against object archives (.a libraries) and dynamic shared object libraries (.so libraries) -Generating statically linked binaries and libraries -Generating dynamically linked libraries -Using the GNU debugging tools -Gdb to debug programs -Graphical debuggers like ddd -Memory debugging/profiling libraries mpatrol and valgrind - Introduction to Bash, sed & awk scripting.

UNIT 5 OPEN-SOURCE PROGRAMMING TECHNIQUES 9 Hrs.

Application Programming-Basics of the X Windows server architecture -Qt programming - Gtk+ programming -Python programming - Execution Environment - Programming GUI applications with localisation support, Open-Source Equivalent of existing commercial software.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understands the importance of open source and how it can be used in efficient manure.
CO2 - Address the importance of licensing, legal impacts.
CO3 - Configure Hardware using Open-Source Tools and Technologies.
CO4 - Familiarize experience with python programming language.
CO5 - Design various system software tools.
CO6 - Implement applications using open-source software.

TEXT / REFERENCE BOOKS

1. N. B. Venkateshwarlu (Ed), “Introduction to Linux: Installation and Programming”, B S Publishers; 2005. (NRCFOSS Publication.
2. Ellen Siever, Stephen Figgins, Robert Love, Arnold Robbins, “Linux in a Nutshell”, Sixth Edition, OReilly Media, 2009

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 Exam Duration: 3 Hrs.

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3849	ADVANCED DEEP LEARNING AND COMPUTER VISION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To address different techniques and algorithms for Dimensionality Reduction
- To Optimize and generalize different Deep Learning networks.
- To implement concepts behind Object Recognition.

UNIT 1 DEEP NETWORK 9 Hrs.

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning.

UNIT 2 DIMENSIONALITY REDUCTION 9 Hrs.

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.

UNIT 3 OPTIMIZATION AND GENERALIZATION 9 Hrs.

Optimization in deep learning– non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT 4 SHAPE REPRESENTATION AND SEGMENTATION 9 Hrs.

Contour based representation, Region based representation, Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, and Multiresolution analysis.

UNIT 5 OBJECT RECOGNITION AND IMAGE UNDERSTANDING 9 Hrs.

Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component Analysis, Shape priors for recognition, Pattern recognition methods, HMM, GMM and EM, Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the concepts of deep learning
CO2 - Apply dimensionality reduction techniques
CO3 - Explore deep learning techniques to support real-time applications
CO4 - Analyze optimization and generalization in deep learning
CO5 - Design deep learning applications
CO6 - Create data models for real world applications.

TEXT / REFERENCE BOOKS

1. CosmaRohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2016.

4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
5. David A. Forsyth, Jean Ponce.” Computer Vision: A Modern Approach”, 2nd Edition Pearson Education Limited, 2015.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3811	REINFORCEMENT AND ENSEMBLE LEARNING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- Understand the basics behind deep reinforcement learning and implementing the code for the same
- Exploring the core challenges and opportunities in the field of deep reinforcement learning
- Implement and apply different reinforcement learning algorithms and ensembling model techniques

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to Deep Reinforcement Learning – Approximate Solution Methods: On-policy Prediction with Approximation – On- policy Control with Approximation – Off-policy Methods with Approximation

UNIT 2 NEURAL NETWORK: RECURRENT AND RECURSIVE 9 Hrs.

Tree Recursive Neural Networks and Constituency Parsing, Recurrent neural networks for language modeling Dynamic Neural Networks for Question Answering

UNIT 3 NEURAL NETWORK: CNN 9 Hrs.

Convolutional neural networks, recurrent and recursive neural networks, backpropagation algorithms, regularization and optimization techniques for training such networks

UNIT 4 REINFORCEMENT LEARNING ALGORITHMS 9 Hrs.

dynamic programming, Monte Carlo, and temporal difference, and function approximation reinforcement learning algorithms, and applications of deep and reinforcement learning – Value function methods, Deep RL with Q-learning – Multi agent RL - Eligibility Traces – Policy Gradient Methods – Applications and Case studies

UNIT 5 ENSEMBLING MODELS 9 Hrs.

Ensemble models –Applications of Ensembling– Types and techniques of Ensembling–Graphical models –Evaluation measures –Hypothesis testing –Cross-validation and Hyperparameter optimization–Bootstrapping and Uncertainties

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the basics of deep reinforcement learning.
CO2 - Implement in code deep reinforcement learning algorithms.
CO3 - Explore the core challenges and opportunities in the field of deep reinforcement learning.
CO4 - Apply Monte Carlo reinforcement learning algorithms
CO5 - Implement temporal-difference reinforcement learning algorithms
CO6 - Develop ensembling models.

TEXT / REFERENCE BOOKS

1. Deb, K.: Optimization for Engineering Design, PHI, India, 2000.
2. Deb, K.: Multi-objective Optimization using Evolutionary Algorithms, Wiley, Uk, 2001
3. Relf, Christopher G.,"Image acquisition and processing with LabVIEW", CRC press
4. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons.
5. Chris Solomon, Toby Breckon,"Fundamentals of Digital Image Processing- A Practical Approach with Examples in Matlab", John Wiley & Sons

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3812	STREAM ANALYTICS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To optimize business decisions and create competitive advantage with Big Data analytics
- To explore the fundamental concepts of stream data analytics
- To learn the math concepts needed for analytics
- To analyze various tools for analytics.

UNIT 1 OVERVIEW 9 Hrs.

Static data analytics vs stream analytics –- Batch data processing architecture – stream Stream data processing architecture – stream Analytics Scenarios – How Stream Analytics work – Advantages of Stream Analytics – Disadvantages of Stream Analytics – Importance of Real time Analytics

UNIT 2 STREAMING DATA SOURCES 9 Hrs.

Real-time or streaming data sources - Issues in Online Sources: Models and Issues in Data Stream Systems, Challenges, opportunities, and pitfalls in online social networks - Reliance on Online Data : Trust, credibility, and reputations - Online social Media and Policing: Behavior, Perceptions - Challenges Information Privacy: Information privacy disclosure, revelation and its effects in OSM and online social networks, Phishing in Online Social Media & Identifying fraudulent entities in online social networks.

UNIT 3 STREAM PROCESSING MODEL 9 Hrs.

Data stream -Data Stream processing model Algorithms for streams-Filtering Data Streams-Moment-The Alon-Matias-Szegedy (AMS) Algorithm for Second Moments-Counting item sets-Sliding Windows-The Datar-Gionis-IndykMotwani Algorithm (DGIM)- Real Time application.

UNIT 4 LINEAR ALGEBRA 9 Hrs.

Matrix, Representation, Examples of matrix Data, Vectors, examples, Representation, Matrix Addition, Scalar Multiplication, Matrix Multiplication properties, Matrix Vector Multiplication, MatrixMultiplication, Inverse and Transpose, Applications of Matrix operations on Real Time Data, Parallel Matrix Multiplication, Dimensionality Reduction by Principal Component Analysis and Eigen Values, Eigen Vectors.

UNIT 5 STREAM PROCESSING TOOLS 9 Hrs.

Apache tools: Kafka, Spark, Storm, and Flink - Amazon tools: Kinesis Streams, Kinesis, and Firehose - Real-time analytical instruments: Azure Stream Analytics – Google Cloud Stream Analytics - Oracle Stream Analytics - real-world streaming analytics use cases: Uber: Chaperone auditing tool - Netflix: Keystone Streaming Platform and Mantis

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Have insights about stream data analytics and the importance of it.
CO2 - Understand the importance of privacy while using the Data.
CO3 - Exploit required algorithm needed for analytics.
CO4 - Understand the underlying mathematics which is essential for analytics.
CO5 - Analyze various tools and instruments for stream analytics.
CO6 - Apply stream processing models and tools to real life societal needs

TEXT / REFERENCE BOOKS

1. AninditaBasak, Krishna Venkataraman, Ryan Murphy, Manpreet Singh, Stream Analytics with Microsoft Azure, Packt Publishing Limited, 2017.
2. Andrew G. Psaltis, Streaming Data Understanding the real-time pipeline, Manning Publications, 2017.Life 3.0, Max Tegmark, 2017

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3812	COMPUTAIONAL COMPLEXITY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the modes of computations such as deterministic, non-deterministic, parallel, randomized and alternating.
- To understand and analyze the NP and NP completeness and Turing Problems
- To introduce the applications of complexity theory to cryptography

UNIT 1 INTRODUCTION 9 Hrs.

Basic Complexity Classes: Class P, Class NP – Computational Model – Turing Machines NP and NP Completeness: Cook-Levin Theorem – coNP – EXP – NEXP – NP Diagonalization: Time Hierarchy Theorem – Space Hierarchy Theorem – Nondeterministic Time Hierarchy Theorem – Ladners Theorem.

UNIT 2 SPACE COMPLEXITY, POLYNOMIAL HIERARCHY AND CIRCUITS 9 Hrs.

Space Complexity: PSPACE Completeness – NL Completeness. Polynomial Hierarchy and Alternations: Properties of Polynomial Hierarchy – Complete Problems for levels of PH – Alternating Turing Machines – Time Versus Alternations.

Circuits: Boolean Circuits – Karp Lipton Theorem – Circuit Lower Bounds – Non-uniform hierarchy theorem – Parallel Computation and NC – P-Completeness – Circuits of Exponential Size.

UNIT 3 RANDOMIZED COMPUTATION 9 Hrs.

Randomized Computation – Probabilistic Turing Machines – Probabilistic Primality Testing – Polynomial Identity Testing – Perfect Match in a Bipartite Graph – One Sided and Zero-sided Error – Randomness Efficient Error Reduction – Randomized Reductions – Randomized Space Bounded Computation.

UNIT 4 IP, CRYPTOGRAPHY AND DECISION TREES 9 Hrs.

Interactive Proofs: The Class IP - Public Coins and AM – IP, PSPACE – Multiprover Interactive Proofs Complexity of Counting: Class #P - #P Completeness – Todas Theorem.

Cryptography: One way functions and pseudorandom random generators – Applications.

Decision Trees: Randomized Decision Theory – Lower bounds on Randomized Complexity – Comparison Trees and Sorting Lower bounds – Yao's MinMax Lemma.

UNIT 5 DECISION TREES, COMPUTATION COMPLEXITY AND LOWER BOUNDS 9 Hrs.

Computation Complexity – Lower Bound Methods – Multiparty Communication Complexity – Probabilistic Communication Complexity.

Circuit Lower Bounds – Circuits with Counters – Lower bounds for monotone circuits – Circuit complexity, Algebraic Computation Models – Algebraic circuits – Algebraic Computation Trees – Blum-Shub-Smale Model – Complexity Classes over the Complex Numbers - Hilbert's Nullstellensatz.

Max.45 Hrs.

COURSE OUTCOMES

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

CO1 - Formulate computational models with resource constraints, and to describe relationships between these models.

CO2 - Analyse computational problems from a complexity perspective.

CO3 - Apply mathematical skills and knowledge from the historic data to concrete problems in computational complexity.

CO4 - Understand the importance of P, NP, Space and complexity classes

CO5 - Concept of interactive proofs in optimization problems.
CO6 - Analyse various space complexity

TEXT / REFERENCE BOOKS

1. Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press, Edition I, 2009
2. O. Goldreich. Computational complexity: a conceptual perspective. Cambridge University Press, 2008
3. O. Goldreich. P, NP, and NP-completeness. Cambridge University Press, 2010.
4. Christos H. Papadimitriou, Computational complexity. Addison-Wesley, 1994.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3814	ROBOTICS AND AUTOMATION	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on various drive system, sensor and machine vision system, manipulators, grippers as well as the various dynamic process.
- To acquire the concept of kinematics and inverse kinematics
- To design programming and specific industrial applications

UNIT 1 BASIC CONCEPTS 9 Hrs.

Origin & various generation of Robots - Robot definition - Robotics system components - Robot classification Coordinate frames
- Asimov's laws of robotics - degree of freedom - dynamic stabilization of robots. - work volume. Need for Automation- types of automation - fixed, programmable and flexible automation.

UNIT 2 DRIVES SENSORS AND MACHINE VISION 9 Hrs.

Hydraulic, pneumatic and electric drives - determination of HP of motor and gearing ratio - variable speed arrangements - path determination - micro machines in robotics - machine vision - ranging - laser - acoustic - magnetic, fiber optic and tactile sensors.

UNIT 3 MANIPULATORS, GRIPPERS AND ROBOT DYNAMICS 9 Hrs.

Construction of manipulators - manipulator dynamics and force control - electronic and pneumatic manipulator control circuits - end effectors - various types of grippers - design considerations. Introduction to Robot Dynamics - Lagrange formulation - Newton Euler formulation - Properties of robot dynamic equations.

UNIT 4 KINEMATICSAND PATH PLANNING 9 Hrs.

Forward Kinematics – DenavitHartenberg Representation- multiple solution Jacobian work envelop, Inverse Kinematics - Geometric approach- Hill climbing techniques – Newton Euler formulation – Analytical mechanics: Hamilton's principle – Lagrange's equations for Robotic Systems

UNIT 5 PROGRAMMING LANGUAGES AND APPLICATIONS 9 Hrs.

Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Robots for welding, painting and assembly - Remote Controlled robots - robots in manufacturing and non- manufacturing applications - Robots for nuclear and chemical plants – Image based control robotic systems

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Summarize knowledge of basic concepts of robotic system
CO2 - Analyze the function of sensors and machine vision system in robot
CO3 - Categorize the drives, manipulators and grippers
CO4 - Develop the qualitative knowledge of Robot dynamics and kinematics
CO5 - Evaluate the recent trends and applications of robotics in various fields
CO6 - Propose the theoretical concepts through specific experimental tasks.

TEXT / REFERENCE BOOKS

1. MikellP.WeissG.M.,NagelR.N.,OdrajN.G.,"IndustrialRobotics",McGraw-HillSingapore,1996.
2. Ghosh,"ControlinRoboticsandAutomation:SensorBasedIntegration",AlliedPublishers,Chennai,1998.
3. Asfahi C.R., "Robotics and Manufacturing Automation" John Wiley, USA,1992
4. Klaffer R.D., Chimieleswski T.A., Negin.M.,"Robotics Engineering- an Integrated approach", Prentice Hall of India, New Delhi, 1994
5. M.P.Groover, Industrial Robotics-Technology, Programming and Applications, TATA McGrawHill Publishing Company, New Delhi, 2008
6. Mc Kerrow P.J., Introduction to Robotics, Addison Wesley, USA, 1991
7. Fu K.S. Gonzaleaz RC and Lee CSG, Robotics Control Sensing, Vision and Intelligence, McGraw Hill International Editions, 1987
8. Janakiraman P.A.,- Robotics and Image processing, Tata McGraw Hill, 1995
9. Deb S.R, "Robotics Technology and Flexible Automation, Tata McGraw Hill, New Delhi, 1994

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SMTB1601	OPTIMIZATION TECHNIQUES FOR COMPUTING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To solve problems in linear programming and Integer programming
- To develop in a student efficient and effective deployment of an organization's resources when they are needed
- To analyze and appreciate variety of performance measures for various optimization problems.

UNIT 1 INTRODUCTION TO LINEAR PROGRAMMING PROBLEM 9 Hrs.

Operations Research(OR)- Nature – Characteristics – Phases - Role of OR in Decision making – Outline of OR Models Linear Programming – Formulation of L.P .problems –Solution by graphical method, simplex method, Big M methods -Duality in LPP and Dual Simplex Method.

UNIT 2 LINEAR PROGRAMMING EXTENSIONS 9 Hrs.

Transportation problem – Initial Basic feasible solution- Northwest corner method, Least Cost method, Vogel's approximation method – Test for optimality-MODI. Assignment problems- Hungarian assignment models-Travelling salesman problems

UNIT 3 RESOURCE SCHEDULING AND NETWORK ANALYSIS 9 Hrs.

Problem of Sequencing – Problem with N jobs and 2 machines N Jobs 3 machines N Jobs and m machines. Project Management -Basic concepts–Network construction and scheduling Critical Path Method (CPM) & Program evaluation review technique (PERT).

UNIT 4 INVENTORY MODELS, SIMULATION AND QUEUING THEORY 9 Hrs.

Inventory Control – Various Types of inventory models – Deterministic inventory models – Production model, Purchase model– with and without shortage- Economic Order Quantity (EOQ) – Buffer stock – Shortage quantity, Probabilistic inventory models Queuing theory – Poisson arrivals and exponential service times, Single channel models only. Monte – Carlo simulation.

UNIT 5 GAME THEORY AND REPLACEMENT MODELS 9 Hrs.

Game theory – the formulation of two-person, Saddle point, Maxmini and Minimax principle, Mixed strategies for 2×2 games, Dominance principle, Replacement policy for items whose maintenance cost increases with time- Consideration of time value of money - Replacement policy- Individual, Group replacement of items that fail completely and suddenly.

Max.45 Hrs.

COURSE OOUTCOMES

On completion of the course, student will be able to

CO1 - Formulate the linear programming problems.
CO2 - Analyze transportation and assignment problems.
CO3 - Develop the scheduling systems.
CO4 - Analyze CPM and PERT methods.
CO5 - Describe the different inventory models.
CO6 - Design the Game theory, Queuing theory and examine the replacement model.

TEXT / REFERENCE BOOKS

1. K. Malik, S. K. Yadav, S. R. Yadav, Optimization Techniques. I K International Publishing House Pvt. Ltd; First Edition edition, 2013.
2. PK Gupta, D.S Hira, Operations Research. S Chand, Seventh Rrevised edition, 2014.
3. Sharma S.D, Operation Research Theory, Methods and Application, 17th Edn., Kedar Nath Ram Nath Publication, 2010.
4. Nita H Shah, Ravi M Gor & Hardik Soni, Operation Research, 4th Edn., PHI, 2010.
5. Edwin K. P. Chong & Stanislaw H. Zak, An Introduction to Optimization, Wiley India, 2017.
6. Mohan, Kusum Deep, Optimization Techniques, New Age Science, 2009.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3461	QUANTUM COMPUTING	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand Quantum state transformation and classical computation versions
- To have knowledge on Generalizations and advanced quantum computation algorithms
- To be proficient on the concepts of robust computation and error correction

UNIT 1 QUANTUM BUILDING BLOCKS-I 9 Hrs.

Introduction - Single Qubit Quantum Systems - Multiple Qubit Systems.

UNIT 2 QUANTUM BULDING BLOCKS-2 9 Hrs.

Measurement of multiple Qubit Systems-Quantum State Transformations-Quantum versions of Classical Computations.

UNIT 3 BASIC ALGEBRA FOR QUANTUM ALGORITHMS 9 Hrs.

Introduction-Numbers and Strings-Basic linear algebra-Boolean Functions, Quantum, Bits and Feasibility, Special Matrices, Tricks.

UNIT 4 QUANTUM ALGORITHMS 9 Hrs.

Phil's algorithm, Deutsch's algorithm, Jozsa Algorithms, Simon's Algorithm, Shor's Algorithms, Grover's Algorithms.

UNIT 5 ENTANGLED SUBSYSTEMS AND ROBUST QUANTUM COMPUTATIONS 9 Hrs.

Quantum subsystems and properties of entangled states-Quantum error correction-Fault tolerance and Robust.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Identify, analyse Quantum Building Blocks.
CO2 - Know Quantum state transformations.
CO3 - Explore the advantages and limitations of some Quantum Computation Algorithms
CO4 - Apply advanced quantum computation algorithms
CO5 - Proficiency on the concepts of robust computation and error correction
CO6 - Analyze error correction mechanisms

TEXT / REFERENCE BOOKS

1. Quantum Computing A Gentle Introduction, Eleanor Rieffel and Wolfgang Polak, The MIT Press Cambridge, Massachusetts London.
2. Quantum Algorithms Via Linear Algebra, Richard J. Lipton, Kenneth W. Regan, The MIT Press Cambridge, Massachusetts London, England, 2014.
3. Quantum Computing Devices: Principles, Designs and Analysis, Goong Chen, David A. Church, Berthold-Georg Engler

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A : 10 questions of 2 marks each; No choice **20 Marks**
PART B : 2 questions from each unit of internal choice; each carrying 16 marks **80 Marks**

SCSB3462	FAULT TOLERANT SYSTEM	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To investigate existing fault-tolerant systems.
- To learn both Hardware and software methods
- To address new research topics in the fault tolerance system

UNIT 1 DEPENDABILITY CONCEPTS AND FAULT TOLERANT STRATEGIES 9 Hrs.

Dependable system, techniques for achieving dependability, dependability measures, fault, error, failure, faults and their manifestation, classification of faults and failures. Fault detection, masking, containment, location, reconfiguration, and recovery. Fault tolerant design techniques and Testing: Hardware redundancy, software redundancy, time redundancy, and information redundancy. Testing and Design for Testability.

UNIT 2 INFORMATION REDUNDANCY AND FAULT TOLERANCE IN DISTRIBUTED SYSTEMS 9 Hrs.

Coding techniques, error detection and correction codes, burst error detection and correction, unidirectional codes, Byzantine General Problem, consensus protocols, check pointing and recovery, stable storage and RAID architectures, and data replication and resiliency.

UNIT 3 DEPENDABILITY EVALUATION TECHNIQUES AND TOOLS 9 Hrs.

Fault trees, Markov chains; HIMAP tool. Analysis of fault tolerant hardware and software architectures. System-level fault tolerance and low overhead high-availability technique.

UNIT 4 FAULT TOLERANCE IN REAL-TIME SYSTEMS 9 Hrs.

Time-space tradeoff, fault tolerant scheduling algorithms, Dependable communication: Dependable channels, survivable networks, fault-tolerant routing.

UNIT 5 FAULT TOLERANT INTERCONNECTION NETWORKS 9 Hrs.

Hypercube, star graphs, and fault tolerant ATM switches. Case studies of fault tolerant multiprocessor and distributed systems.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Familiarize with general and state of the art techniques in fault tolerance system
CO2 - Design and analyse fault-tolerant digital systems.
CO3 - Investigate existing fault-tolerant systems.
CO4 - Understand both Hardware and software methods
CO5 - Implement scheduling algorithms in fault tolerant systems.
CO6 - Develop new research topics in the fault tolerance system

TEXT / REFERENCE BOOKS

1. Avizienis and J. Laprie, ``Dependable Computing: From Concepts to Design Diversity," Proc. IEEE, vol.74, no.5, pp.629-638.
2. A.K. Somani and N.H. Vaidya, ``Understanding fault-tolerance and reliability," IEEE Computer, vol.30, no.4, pp.45-50.

3. M. Pease, R.Shostak, and L. Lamport, ``Reaching Agreement in the Presence of Faults," M. Pease, R.Shostak, and L. Lamport, Journal of ACM, #27 (180), pp.228-234.
4. The Byzantine Generals Problem, ACM Trans. Prog. Languages and Systems, 4(1982) pp. 382-401.
5. S. Ghosh, R. Melhem, and D. Mosse, ``Fault-tolerance through scheduling of aperiodic tasks in hard real-time multiprocessor systems," IEEE Trans. Parallel and Distributed Systems, vol.8, no.3, pp.272-284.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3020	SOCIAL NETWORK ANALYSIS	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn mining in social network communities.
- To visualize and apply social networks.

UNIT 1 INTRODUCTION 9 Hrs.

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web Social Network Analysis: Social Networks Perspective - Analysis of Network Data –Key concepts and measurements in network analysis-Interpretation of Network Data - Social Network Analysis in the Social and Behavioral Sciences - Metrics in social network analysis.

UNIT 2 SOCIAL NETWORK ANALYSIS SOFTWARE, TOOLS AND LIBRARIES 9 Hrs.

Modelling and aggregating social network data: Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data –(Advanced representations) Multi-Relational characterization of dynamic social network communities - Social network analysis software - Tools - Libraries.

UNIT 3 CLIQUES, CLUSTERS AND COMPONENTS 9 Hrs.

Components and Sub graphs: Sub graphs - Ego Networks, Triads, and Cliques, Hierarchical Clustering, Triads, Network Density and conflict. Density: Egocentric and Sociocentric - Digression on Absolute Density - Community structure and Density, Centrality: Local and Global - Centralization and Graph Centres, Cliques and their intersections, Components and Citation Circles - Positions, Sets and Clusters.

UNIT 4 PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES 9 Hrs.

Development of Social Network Analysis - Understanding and predicting human behaviour for social communities - User data management - policy, legal, and technical challenges. Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

UNIT 5 VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9 Hrs.

Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Modelling and aggregating social network data - Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Identify metrics used in network analysis.
CO2 - Classify the network related data.
CO3 - Identify the aim of graph in computational models.
CO4 - Apply the knowledge in predicting the user behaviours.

CO5 - Visualize social network using tools.
CO6 - Analyze metrics in social network analysis.

TEXT / REFERENCE BOOKS

1. Jeffrey C Johnson, Martin G Everett, Stephen P Borgatti - Analyzing Social Networks –sage publication-2013.
2. Guandong Xu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
3. Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
4. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
5. John Scott, “Social Network Analysis”, Third Edition, SAGE Publications Ltd 2013.
6. Peter Mika, ―Social Networks and the Semantic Web, First Edition, Springer 2007.
7. Maksim Tsvetovat, Alexander Kouznetsov, “Social Network Analysis for Startups”, First Edition, O’Reilly Media, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3035	COGNITIVE SCIENCE	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To learn basics and develop skills in Cognitive Science with focus on acquisition.
- To understand the mind and intelligence that connects psychology, artificial intelligence, neuroscience and linguistics.
- To gain knowledge about the methods and tools to solve real time issues.

UNIT 1 INTRODUCTION TO COGNITIVE SCIENCE 9 Hrs.

Cognitive view – Fundamental concepts – Computers in cognitive science – Applied cognitive science – Interdisciplinary nature of cognitive science.

UNIT 2 COGNITIVE PSYCHOLOGY 9 Hrs.

Cognitive Psychology: Architecture of the mind - Nature of cognitive psychology - Global view of the cognitive architecture - Propositional representation - Schematic representation - Cognitive processes, Working memory, and attention - Acquisition of skill- Connectionist approach to cognitive architecture.

UNIT 3 LANGUAGE ACQUISITION, SEMANTICS AND PROCESSING MODEL 9 Hrs.

Milestones in acquisition – Theoretical perspectives- Semantics and cognitive science – Meaning and Entailment –Reference – Sense – Cognitive and computational models of semantic processing – Information processing models of the mind- Physical symbol systems and language of thought- Applying the symbolic paradigm- Neural networks and distributed information processing- Neural network models of cognitive processes.

UNIT 4 INTEGRATION CHALLENGE 9 Hrs.

Cognitive Science and integration challenge: Levels of explanation - Local integration -Tackling the Integration Challenge: Inter theoretic reduction - Marr's tri-level hypothesis - Models of mental architecture.

UNIT 5 NEURAL NETWORK MODELS OF COGNITIVE PROCESSES 9 Hrs.

Language learning - Neural network models of children's physical reasoning - Challenges and applications - The massive modularity hypothesis - Hybrid architectures - Tools: Working with concept maps.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the relationships between cognitive systems with different cognitive disciplines.
CO2 - Enumerate the various neuro scientific theories of cognitive systems.
CO3 - Analyze the representation and use of knowledge by individual minds, brains, and machines.
CO4 - Perform neuroscience and linguistics based real time experiments.
CO5 - Implement the knowledge of neuro science with its advanced techniques towards the cognitive field.
CO6 - Formulate hypothesis and computational models to draw conclusions that embeds cognitive psychology and neuroscience.

TEXT / REFERENCE BOOKS

1. Jose Luis Bermudez, “Cognitive Science: An Introduction to the Science of the Mind”, Cambridge University Press, New York, 2014.
2. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein, “Cognitive Science: An Introduction”, 2nd Edition, MIT press, 1995.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks : 100 **Exam Duration : 3 Hrs.**

PART A : 10 Questions of 2 marks each-No choice **20 Marks**
PART B : 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks**

SCSB3820	DIGITAL TRANSFORMATION AND FUTURE SOCIETIES	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To Provide knowledge and overview about Big data, IoT and Artificial Intelligence for Society 5.0
- Discuss To understand Augmented Reality and Virtual Reality, Next Generation Sensors
- To discuss about Challenges and Technologies towards Society 5.0, Security of Cyber Physical Systems
- Discuss to apply society 5.0 Innovation with Future Trends with Applications

UNIT 1 INTRODUCTION TO SOCIETY 5.0 9 Hrs.

Introduction –Schema of society 5.0-Characteristics of Society 5.0. Introduction to communication technologies: Artificial Intelligence – robotics - 3D Printing. People: Centric Society -Knowledge Sharing- Physical space-Cyberspace – Humanity VS Society 5.0 –Elements of Society 5.0-Data Driven to Society- Modeling real world Issues.

UNIT 2 EMERGING TECHNOLOGIES WITH SOCIETY 5.0 9 Hrs.

Introduction to Big Data – Issues and Challenges in the traditional systems –Intelligent Data Analysis – Big Data Storage Statistical Concepts: Sampling Distributions - Re-Sampling - Prediction Error – Random Sampling– Artificial Intelligence – - Foundations of AI - Intelligent agent - Types of agents - Structure - Problem solving agents -Internet of Things- Introduction to IoT- Basic Architecture of an IoT, From M2M to IoT, M2M towards IoT-Robotics- Robotics system components - Robot classification Coordinate frames - degree of freedom - dynamic stabilization of robots.

UNIT 3 INTRODUCTION TO INDUSTRY 4.0 9 Hrs.

Introduction-Globalization and Emerging Issues, LEAN Production Systems, Smart and Connected Business Perspective, Cyber Physical Systems and Next Generation Sensors, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis- An emerging industrial structure for IoT -Cyber security in Industry 4.0-Basics of Industrial IoT. Common Issues in Industry 4.0 and Society 5.0.

UNIT 4 CHALLENGES AND TECHNOLOGIES TOWARDS SOCIETY 5.0 9 Hrs.

Overcome with Economic Development and Solution to Social Problems in Society 5.0- Security of Cyber Physical Systems - Embedded and CPS security - attacks and countermeasures, authentication, identification, confidentiality, data integrity, authorization, access control, malware attacks and counter-measures, security protocols- Social Issues in Society 5.0 - human- centered society (Society 5.0)-Sustainable Development Goals-Economic Advancement- Resolution to Social Problems.

UNIT 5 INNOVATION WITH FUTURE TRENDS WITH APPLICATIONS 9 Hrs.

Mobility – Health Care –Agriculture- Food Products – Disaster Prevention.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Understand the Social Problems By A System That Highly Integrates Cyberspace and Physical Space to solve

CO2 - Get Skills for Economic Development and A Human-Centered Society That Balances Economic Advancement

CO3 - Achieve a High Degree of Convergence Between Cyberspace (Virtual Space) And Physical Space (Real Space)

CO4 - Use of Emerging Technologies with Society 5.0 To Achieve More Production / Avoid Loss of Productions

CO5 - Internet and IoT, Big data for production lines to be adaptive, intelligent, and flexible enough to meet the updated requests.

CO6 - Design and apply in Health Care, Agriculture, Food Products, Disaster Prevention.

TEXT / REFERENCE BOOKS

1. Society 5.0 A People –Centric Super –Smart Society, Hitachi –Utokyo Laboratory, Springer,2020.
2. Society 5.0 Industy of the Future Technologies Methods and Tools By Bruno Salgues,Willey, 2018
3. Stuart J.Russel, Peter Norvig, “Artificial Intelligence A Modern Approach ”, 3rd Edition, Pearson Education,2009.
4. The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi.,2012.
5. McKerrow P.J. “Introduction to Robotics”, Addison Wesley, USA, 1991

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB3821	MOBILE APPLICATION DEVELOPMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand basic concepts of mobile technologies, different operating systems and how to work with Android.
- To develop applications for mobile computing devices, performing tasks at all stages of the software development life-cycle.
- To learn how to cope with objective C programming and deploy mobile applications for iOS.
- To design, implement and deploy mobile applications for windows OS.

UNIT 1 INTRODUCTION TO ANDROID 9 Hrs.

Introduction to mobile technologies, mobile operation systems - pros and cons, Introduction to Android, Features, Architecture, UI Widgets and Events handling, Layouts, Application structure, Android Manifest file, Creating Android applications.

UNIT 2 BUILDING BLOCKS AND DATABASES 9 Hrs.

Introduction to Activities and Intents - Understanding Activity life cycle, Linking Activities, Passing Data, Toast, Displaying a Dialog Window and Notifications. Content Provider, Services, Broadcast receivers, accessing databases, Location and sensors, Multimedia audio, video and camera, Deploying and publishing application.

UNIT 3 OBJECTIVE C PROGRAMMING 9 Hrs.

Objective C - Objects and Classes, Property, Messaging, Categories and Extensions, Fast Enumeration - NSArray, NS Dictionary, Methods and Selectors, Static & Dynamic objects, Exception handling, Memory management, Swift language essentials: Arrays, Dictionaries, functions.

UNIT 4 INTRODUCTION TO IOS 9 Hrs.

Introduction to iPhone, MVC Architecture, View Controller - Building the UI and Event handling, Application life cycle, Tab Bars, Story Boards and Navigation Controllers, Table View, Push Notification, Database handling, Introduction to icloud, Webkit framework in iOS8, Deploying and publishing application.

UNIT 5 WINDOWS MOBILE APP DEVELOPMENT 9 Hrs.

Introduction to Windows Phone 8, Application Life cycle, UI Designing and events, Building, Files and Storage, Network Communication, Push Notification, Background Agents, Maps and Locations, Data Access and storage, Introduction to Silverlight and XAML, Data Binding, Deploying and Publishing.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the technologies and business trends impacting mobile applications.
CO2 - Understand and remember the components of android, iOS and Windows mobile applications.
CO3 - Learn the programming languages and techniques for developing mobile applications.
CO4 - Develop mobile applications with compelling user interface and database connectivity for real time applications for iOS.
CO5 - Deploy applications with compelling user interface and database connectivity for real time applications for Windows OS.
CO6 - Develop and deploy mobile applications using silverlight.

TEXT / REFERENCE BOOKS

1. Reto Meier, “Professional Android Application Development”, Wrox, 2010.
2. http://developer.android.com/training/index.html
3. Stephen G. Kochan, “Programming in Objective C”, Dorling Kindersley India Pvt. Ltd, 2012.
4. David Mark, Jack Nutting and Jeff LaMarche, “Beginning iOS 6 Development Exploring the iOS SDK”, Apress, 2013.
5. Henry Lee, Eugene Chuvyrov, “, Beginning Windows Phone App Development”, Apress 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

LIST OF MANAGEMENT ELECTIVES

SBAB4001	PRINCIPLES AND PRACTICES OF MANAGEMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To analyze how the field of Management has evolved and its significant contributions
- To analyze and apply the critical role of managers in modern organizational settings.
- To illustrate and evaluate the importance of planning, organizing, directing and controlling in decision making.

UNIT 1 INTRODUCTION 9 Hrs.

Definition, Functions, Process, Scope and Significance of Management. Nature of Management, Managerial Roles, Managerial Skills and Activities, Difference between Management and Administration. Significance of Values and Ethics in Management.

UNIT 2 SCHOOLS OF MANAGEMENT 9 Hrs.

Evolution of Management Thought - Contributions of F.W. Taylor, Henry Fayol, Elton Mayo, Approaches of Management Thought (including MBO & MBE) Functions of Management. Concept of Leadership- Theories and Styles

UNIT 3 PLANNING AND ORGANIZING 9 Hrs.

Nature, Scope, Objective and Significance of Planning, Elements and Steps of Planning, Decision Making Organizing Principles, Span of Control, Line and Staff Relationship, Authority, Delegation and Decentralization. Effective Organizing, Organizational Structures, Formal and Informal Organizations, Staffing.

UNIT 4 DIRECTING 9 Hrs.

Effective Directing, Supervision**, Motivation**: Different Theories of Motivation - Maslow, Herzberg, Mc Clelland, Vroom, Porter and Lawler, Job Satisfaction. **Communication** Process, Channels and Barriers, Effective Communication.

UNIT 5 CONTROLLING AND COORDINATING 9 Hrs.

Elements of Managerial Control, Control Systems, Management Control Techniques, Effective Control Systems. Coordination Concept, Importance, Principles and Techniques of Coordination, Concept of Managerial Effectiveness.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understanding of basic management concepts, principles, and practices.
CO2 - Develop planning and decision-making strategies in an organization.
CO3 - Summarize the concept and complete the process of organizing.
CO4 - Develop an understanding of staffing, leadership, directing and motivation in an organization.
CO5 - Predict the dynamics of controlling and its emerging issues in management.
CO6 - Assess managerial practices and choices relative to ethical principles and standards

TEXT / REFERENCE BOOKS

1. Stephen P. Robbins, David A. Decenzo, Fundamentals of Management, Pearson Education, 9th Edition.
2. Harold Koontz, O'Donnell and Heinz Weihrich, Essentials of Management. New Delhi, 9th edition, Tata McGraw Hill.
3. Management Fundamentals: Concepts, Applications, & Skill Development, 6th edition, Sage.
4. Richard L. Daft, Principles of Management, Cengage Learning.
5. Prasad, L.M. Principles and Practice of Management, Sultan Chand.
6. Jhunjhunwala J Mohanty, Management Principles and Applications, Himalaya Publishing House.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

S41BPB41	VENTURE CREATION	L	T	P	EI	Credits	Total Marks
		2	0	0	3	3	100

COURSE OBJECTIVES

- To develop an entrepreneurial mindset, understand the concept of entrepreneurship and identify personal strengths and weaknesses
- To understand the design thinking process and apply design thinking to real-world problems
- To identify problems and opportunities and develop ideas for new ventures by assessing market potential
- To develop a value proposition, business model canvas, build MVP to create sustainable differentiation for the venture with a well-structured business plan, unit economics, go-to-market strategies and funding plan for managing business growth
- To build an idea pitch and deliver it with confidence to potential stakeholders

UNIT 1 INTRODUCTION TO ENTREPRENEURSHIP 9 Hrs.

Defining Entrepreneurship, evolution the concept & Emerging Trends in Entrepreneurship (Domain specific), Understanding the unique opportunities; Why be an entrepreneur? Entrepreneurship in Indian Scenario & Its role in economic development; Success stories of Entrepreneur (Domain specific); Entrepreneurial style assessment tool; Developing the Entrepreneurial mindset- Attributes & skills, recognizing your sweet spot for starting up; Principles of Effectuation; Myths about Entrepreneurship; Types of Entrepreneurs; Entrepreneur vs Intrapreneur; Role of Entrepreneurial Teams

UNIT 2 DESIGN THINKING AND OPPORTUNITY DISCOVERY 9 Hrs.

Introduction to Design Thinking for startups; Design Thinking principles & process; Define the problem using Design thinking principles and validate Problem; Generation of ideas, Idea generation techniques and evaluating creative ideas; Identify problem worth solving; Sharpen your Problem Pitch

UNIT 3 CUSTOMER, MARKETS AND CREATING A SUSTAINABLE DIFFERENTIATION 9 Hrs.

Differentiate between a customer and a consumer; Who is your customer and what is your segment; Customer Job, Pains, and Gains using Value proposition Canvas; Build solution using Value Proposition Canvas; Market Estimation-TAM, SAM, SOM; Competitive analysis; Minimum viable product – what is MVP: Build - Measure - Learn, differentiate between solution Demo & MVP; How to validate MVP- Achieve a Product – Market fit

UNIT 4 BUSINESS MODEL, BUSINESS PLANNING AND GO TO MARKET STRATEGIES 9 Hrs.

Introduction to Business model, Business plan; Lean approach 9 block lean canvas model; Financial feasibility: Costs, revenue streams, Pricing, Financial Projections, Key Financial Metrics using financial template, managing growth & targeting scale, Unit economics; Selecting the Right Channel; Introduction to Digital Marketing and tools; Branding strategy

UNIT 5 FUNDING STRATEGY 9 Hrs.

Sources of funds: Debt & Equity; Map the Start-up Lifecycle to Funding Options; Build an Investor ready pitch deck

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Define entrepreneurship and explain emerging trends in entrepreneurship

CO2 - Identify and evaluate business opportunities and assess market potential

CO3 - Conduct customer discovery, market research, build a lean canvas, develop a business plan and marketing strategies

CO4 - Develop a funding strategy, understand basic legal requirement for starting and running a business

CO5 - Build an idea pitch and deliver it with confidence to various stakeholders.

CO6 - Apply design thinking principles and processes to real-world problems, generate creative ideas, and develop a problem pitch for potential solutions.

TEXT / REFERENCE BOOKS

1. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. Entrepreneurship (10th ed.). McGraw-Hill Education. (2017).
2. Ries, E. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business. (2011).
3. Blank, S. G., & Dorf, B. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. K&S Ranch. (2012).
4. Roy, R. Indian Entrepreneurship: Theory and Practice. New Delhi: Oxford University Press. (2017).
5. Chandan, J. S., & Rana, S. S. Entrepreneurship Development and Management. New Delhi: McGraw Hill Education. (2019).
6. Sinek, S. Start with Why: How Great Leaders Inspire Everyone to Take Action. Portfolio. (2011).
7. Choudhary, R., & Mehta, N. From Zero to One: How to Build a Successful Startup in India. Notion Press. (2019).
8. Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons. (2010).
9. Mitra, P., & Banerjee, A. Startup Minds: The Entrepreneur's Journey from Idea to Success. SAGE Publications India. (2019).
10. Thiel, P. Zero to One: Notes on Startups, or How to Build the Future. Crown Business. (2014).
11. Zappos, T. Delivering Happiness: A Path to Profits, Passion, and Purpose. Business Plus. (2010).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB4006	SOFTWARE PROJECT MANAGEMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To understand the fundamental principles of software project management.
- To have a good knowledge of responsibilities of project manager.
- To be familiar with the different methods and techniques used for project management

UNIT 1 INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT 9 Hrs.

Introduction to Software Project Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Categorizing Software Projects, Project Evaluation and Programme Management, Project Portfolio Management, Evaluation of Individual Projects, Cost–benefit Evaluation Techniques, Risk Evaluation, Programme Management, Managing the Allocation of Resources within Programme Management, An Overview of Project Planning.

UNIT 2 SELECTION OF APPROPRIATE PROJECT APPROACH, EFFORT ESTIMATION 9 Hrs.

Selection of an Appropriate Project Approach, Choosing Methodologies and Technologies, Software Processes and Process Models, Choice of Process Models, Structure versus Speed of Delivery, Software Effort Estimation, Problems with Over and Under-Estimates, Software Effort Estimation Techniques, Bottom-up Estimation, Top-down Approach and Parametric Models, Expert Judgment, estimating by Analogy, COCOMO Model, Cost Estimation, Staffing Pattern, Effect of Schedule Compression.

UNIT 3 ACTIVITY PLANNING AND RISK MANAGEMENT 9 Hrs.

Activity Planning, Project Schedules, Projects and Activities, Sequencing and Scheduling Activities, Network Planning Models, Risk Management, Categories of Risk, Risk Management Approaches, A Framework for Dealing with Risk, Risk Identification, Risk Assessment, Risk Planning, Risk Management, Boehm's Top 10 Risks and Counter Measures, Resource Allocation, Nature of Resources, Identifying Resource Requirements, Scheduling Resources, Creating Critical Paths, Counting the Cost.

UNIT 4 MONITORING AND CONTROL 9 Hrs.

Monitoring and Control, Creating the Framework, Collecting the Data, Review, Visualizing Progress, Cost Monitoring, Earned Value Analysis, Prioritizing Monitoring, Getting the Project Back to Target, Change Control, Software Configuration Management, Managing Contracts, Managing People in Software Environments, Understanding Behavior, Organizational behavior, Selecting the Right Person for the Job, Instruction in the Best Methods, Motivation, The Oldham–Hackman Job Characteristics Model, Stress Management.

UNIT 5 SOFTWARE QUALITY 9 Hrs.

Software Quality, Importance of Software Quality, Defining Software Quality, Software Quality Models, ISO 9126, Product and Process Metrics, Product versus Process Quality Management, Quality Management Systems, Process Capability Models, Techniques to Help Enhance Software Quality, Testing, Software Reliability, Quality Plans.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply project management concepts and techniques to an IT project.
CO2 - Identify issues that could lead to IT project success or failure.
CO3 - Explain project management in terms of the software development process.
CO4 - Describe the responsibilities of IT project managers.
CO5 - Apply project management concepts through working in a group as team leader
CO6 - Be an active team member on an IT project.

TEXT / REFERENCE BOOKS

1. Bob Hughes, Mike Cotterell, Rajib Mall, Software Project Management, TMH Edition 6, 2018.
2. Walker Royce, Software Project Management, Pearson Edition, 2005.
3. Stellman and Greene, Applied Software Project Management 1st Edition, Kindle Edition
4. Richard Thayer, Edward Yourdon, Software Engineering Project Management, WILEY
5. Jack Marchewka, Information Technology Project Management providing measurable organizational value, WILEY

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**

SCSB1714	SMART PRODUCT DEVELOPMENT	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVES

- To introduce basic working principles of sensor devices
- To educate different interface medium for communication
- To impart knowledge on different automation system

UNIT 1 INTRODUCTION TO SENSOR DEVICES 9 Hrs.

Piezoresistive pressure sensor- Piezoresistive Accelerometer - Capacitive Sensing- Accelerometer and Microphone - Resonant Sensor and Vibratory Gyroscope - Low-Power, Low Voltage Sensors- Micro Electro Mechanical Systems Analysis and Design of MEMS Devices- Nano Sensors.

UNIT 2 INTERFACING SENSOR INFORMATION AND MCU 9 Hrs.

Amplification and Signal Conditioning- Integrated Signal Conditioning- Digital conversion- MCU Control MCUs for Sensor Interface Techniques and System Considerations- Sensor Integration.

UNIT 3 CONTROL TECHNIQUES AND STANDARDS 9 Hrs.

Control of Sensors using - State Machines, Fuzzy Logic, Neural Networks, Adaptive Control. Control Application using - CISC, RISC, DSP Control and IEEE 1451 Standards.

UNIT 4 COMMUNICATION FOR SMART SENSORS 9 Hrs.

Wireless Data Communications- RF Sensing- Telemetry- Automotive Protocols- Industrial Networks Home Automation- MCU Protocols.

UNIT 5 SMART CITY - CASE STUDY 9 Hrs.

Smart Adaptive advertising - Customized Digital experience, Disaster Prevention, Smart Agriculture, Smart Health, Smart Security & Surveillance, Smart Virtual Assistance – Leadership & Policy Makers, Challenges & Solutions in Building AI, IoT, case study: IoT Application for Water & Waste Management.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course the student will be able to

CO1 - Comprehend the requirements of product design
CO2 - Analyze of different design.
CO3 - Develop different interfaces
CO4 - Work in different communication medium
CO5 - Understand the automation process
CO6 - Develop applications using AI technique

TEXT / REFERENCE BOOKS

1. Designing the Internet of Things, Adrian McEwen & Hakim Cassimally, Wiley, 2014.
2. Smart Sensors for Industrial Applications (Devices, Circuits, and Systems) by Krzysztof Iniewski, CRC Press, 2017.
3. IOT Google, Amazon Alexa, Signal Jammer, ESP 8266 NodeMCU and Location Tracker etc..,: New model technology development, Anbazhagan k, 2019 .

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100 **Exam Duration: 3 Hrs.**

PART A :	10 questions of 2 marks each; No choice	**20 Marks**
PART B :	2 questions from each unit of internal choice; each carrying 16 marks	**80 Marks**