B.TECH. III Semester-5	L	T	P	C
EE 501: Control Systems	3	0	2	4

Introduction to Control Systems, Mathematical Modelling of Control Systems	8 Hours
Introduction to Control Systems: Introduction, Examples of Control Systems, Closed-Loop Control Versus Open-Loop Control, Design and Compensation of Control Systems Mathematical Modelling of Control Systems: Introduction, Transfer Function and Impulse-Response Function, Automatic Control Systems, Modelling in State Space, State-Space Representation of Scalar Differential Equation Systems, Linearization of Nonlinear Mathematical Models Mathematical Modelling of Mechanical Systems and Electrical Systems	
Transient and Steady-State Response Analyses	**8 Hours**
Introduction, First-Order Systems, Second-Order Systems, Routh's Stability Criterion, Effects of Integral and Derivative Control Actions on System Performance, Steady-State Errors in Unity-Feedback Control Systems	
Control Systems Analysis and Design by the Root-Locus Method	**8 Hours**
Introduction, Root-Locus Plots, Root-Locus Plots of Positive Feedback Systems, Root-Locus Approach to Control System Design, Lead Compensation, Lag Compensation, Lag-Lead Compensation, Parallel Compensation	
Control Systems Analysis and Design by the Frequency Response Method	**12 Hours**
Introduction, Bode Diagrams, Polar Plots, Log-Magnitude-versus-Phase Plots, Nyquist Stability Criterion, Stability Analysis, Relative Stability Analysis, Closed-Loop Frequency Response of Unity-Feedback Systems, Experimental Determination of Transfer Function, Control Systems Design by Frequency-Response approach, Lead Compensation, Lag Compensation, Lag-Lead Compensation	
Control Systems Analysis and Design in State Space	**6 Hours**
Introduction, State-Space Representations of Transfer-Function Systems, Controllability, Observability, Pole Placement	
Total Contact Time: 42 Hours	

Recommended Books

1. Modern Control Engineering, 5th Edition, by Katsuhiko Ogata.
2. FaridGolnaraghi and Benjamin C Kuo, Automatic Control Systems, 9th Edition, John Wiley and Sons
3. I. J. Nagrath and M. Gopal, Control Systems Engineering, 4th Ed., New age international publishers.
4. D'Azzo and Houpis, Feedback Control Systems, Analysis and Synthesis, 1988.
5. Richard M. Murray and Karl J. Astrom, Feedback Systems: An introduction for Scientists and Engineers, Princeton University Press, 2010.

B.TECH. III Semester-5	L	T	P	C
EC 502: Digital Integrated Circuits	3	0	2	4

Prerequisite
MOS Fundamentals

Introduction to Integrated Circuits, The Manufacturing Process, and The Devices	6 Hours
A Historical Perspective, Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design: Cost of an Integrated Circuit, Functionality and Robustness, Performance, Power and Energy Consumption Manufacturing CMOS Integrated Circuits: The Silicon Wafer, Photolithography, Some Recurring Process Steps, Simplified CMOS Process Flow, Design Rules — The Contract between Designer and Process Engineer Packaging Integrated Circuits: Package Materials, Interconnect Levels, Thermal Considerations in Packaging Perspective (Trends in Process Technology): Short-Term Developments, In the Longer term The Spice Diode Model, SPICE Model for the MOS Transistor, A word on Process Variation Perspective: Technology Scaling	
Digital Logic Inverter & The CMOS Inverter	**12 Hours**
Digital Logic Inverter: Function of the Inverter, The Voltage Transfer Characteristics (VTC), Noise Margins, The Ideal VTC, Inverter Implementation, *Resistively Loaded MOS Inverter, The Saturated NMOS-Load Inverter,* Power Dissipation, Propagation Delay, Power-Delay and Energy-Delay Products CMOS Inverter: Circuit Operation, The Voltage-Transfer Characteristics, The Situation Where Q_N and Q_P are not matched	
CMOS Logic-Gate Circuits **IC Digital Logic Families**	**12 Hours**
CMOS Logic-Gate Circuits: Basic Structure, The two-input NOR Gate, The two-input NAND Gate, A Complex Gate, Obtaining the PUN from the PDN and Vice Versa, The Exclusive-OR Function, Summary of the Synthesis Method, Transistor Sizing, Effects of Fan-In and Fan-Out on Propagation Delay RTL: RTL basic NOR Gate DTL: DTL basic NAND Gate, Modified DTL Gate HTL: HTL Gate I^2L: I^2L basic Gate, Connection of other gates to the inputs and outputs of a basic I^2L gate, Typical Connections among I^2L gates	
Introduction to IC Digital Logic Families **Memory Circuits**	**12 Hours**
TTL: TTL Versions and their characteristics, Open-Collector TTL gate, Wired-AND of two open-collector gates, Open-Collector gates forming a common bus line, TTL gate with totem-pole output, Schottky TTL gate, Three-state TTL gate ECL: The Basic Principle, ECL Families, The Basic Gate Circuit, Voltage Transfer Characteristics (OR VTC, NOR VTC), Fan-Out, Speed of Operation and Signal Transmission, Power Dissipation, Thermal Effects, The Wired-OR Capability, Final Remarks Introduction Semiconductor Memories (Types and Architectures): Memory-Chip Organisation, Memory-Chip Timing Random-Access Memory (RAM) Cells: Static Memory Cell (The Red Operation, The Write	

Operation), Dynamic Memory Cell The Sense Amplifier: A Sense Amplifier with Positive Feedback, A closer look at the Operation of the Sense Amplifier, Obtaining Differential Operation in Dynamic RAMs, Alternative Precharging Arrangement, An Alternative Sense Amplifier Address Decoders: The Row address decoder, The Column Address Decoder Read-Only Memory (ROM): A MOS ROM, Mask-Programmable ROMs, Programmable ROMs (PROMs and EPROMs) ***Introduction to FPGA***
Total Contact Time: 42 Hours

Recommended Books
1. Rabaey Jan, ChandrakasanAnantha Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Ed., 2nd Impression, 2008. 2. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, Oxford University Press, 6th Edition. 3. “Digital Logic and Computer Design”, Mano Morris, 3rd Edition, Pearson Education, 2005. 4. Sung-Mo Kang and Leblebici Y., "CMOS Digital Integrated Circuits: Analysis And Design", Tata McGraw-Hill, 3rd Ed., 2003. 5. Weste Neil H.E, Harris D. and Banerjee A., "CMOS VLSI Design: A Circuits And Systems Perspective", Pearson Education, 3rd Ed., 2002.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
EC 503: Digital Signal Processing	**3**	**0**	**2**	**4**

Introduction **Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT)**	**10 Hours**
Review of Discrete Time Signals and Systems and Z-Transforms, Solution of Difference Equations Using One-sided z-Transform, Frequency domain Characteristics of LTI Systems, LTI Systems as Frequency-Selective Filters. Discrete Fourier Transform and its Properties, Divide and Conquer Approach, Radix-2Decimation in Time and Decimation in Frequency FFT Algorithms.	
Implementation Of Discrete-Time Systems	**10 Hours**
Structures for the Realization of Discrete-Time Systems, Structures for FIR Systems, Direct-Form Structure, Cascade-Form Structures. Frequency-Sampling Structures, Lattice Structure. Structures for IIR Systems, Direct-Form Structures. Signal Flow Graphs and Transposed Structures. Cascade-Form Structures, Parallel-Form Structures. Lattice and Lattice-Ladder Structures for IIR Systems.	
Design Of Digital Filter	**10 Hours**
Design of digital filters – general considerations – causality and its implications, characteristics of practical frequency selective filters. Design of FIR Filters, Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method. IIR filter design: Discrete time IIR filter (Butterworth and Chebyshev) from analog filter – IIR filter (LPF, HPF, BPF, BRF) design by Impulse Invariance, Bilinear	

transformation, Approximation of derivatives. Design of IIR Filters in the Frequency Domain.
Finite word length effects in digital Filters and Mutirate DSP **12 Hours**
Fixed point and floating point number representations - Comparison -Truncation and Rounding errors - Quantization noise - derivation for quantization noise power - coefficient quantization error - Product quantization error - Overflow error – Round-off noise power - limit cycle oscillations due to product round-off and overflow errors - signal scaling. Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design & Implementation for Sampling-Rate Conversion, Direct-Form FIR Filter Structures, Polyphase Filter Structures, Time-Variant Filter Structures. Applications of Multirate Signal Processing.
Total Contact Time: 42 Hours

Recommended Books

1. John G. Proakis& Dimitris K. Manolakis,"Digital Signal Processing", 4th Edition, Prentice Hall.
2. Alan V. Oppenheim & Ronald W. Schafer, "Discrete-Time Signal Processing", 3rd Edition, PHI.
3. SanjitMitra, "Digital Signal Processing", 4th Edition, 2011, McGraw-Hill.
4. C. Gnanapriya&Salivahanan, "Digital Signal Processing", 2nd Edition, 2011, TMH.
5. B. P. Lathi, "Principles of Signal Processing & Linear Systems", 6th Edition, OUP.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
AE 504: Economics and Business Management	**3**	**0**	**0**	**3**

Economics **6 Hours**
Introduction To Economics, Micro & Macro Economics, Applications & Scopes Of Economics, Demand Analysis, Demand Forecasting, Factors Of Production, Types Of Cost, Market Structures, Break Even Analysis
Management **12 Hours**
Introduction To Management, Features Of Management, Nature Of Management, Development Of Management Thoughts – Scientific Management By Taylor & Contribution Of Henry Fayol, Coordination & Functions Of Management, Centralization & Decentralization, Decision Making Fundamentals Of Planning Objectives & MBO Types Of Business Organizations: Private Sector, Public Sector & Joint Sector Theories Of Motivation, Leadership
Functional Management **20 Hours**
Marketing Management: Core Concepts Of Marketing, Marketing Mix (4p), Segmentation – Targeting – Positioning, Marketing Research, Marketing Information System, Concept Of International Marketing, Difference Between Domestic Marketing & International Marketing *Operations Management*: Introduction To Operations Management, Types Of Operation Systems, Types Of Layouts, Material Handling, Purchasing & Store System, Inventory Management Personnel Management: Roles & Functions Of Personnel Manager, Recruitment, Selection, Training, Industrial Dispute, Collective Bargaining *Financial Management*: Goal Of Financial Management, Key Activities In Financial Management,

Organization Of Financial Management, Financial Institutions, Financial Instruments, Sources Of Finance	
Modern Management Aspects	**4 Hours**
Introduction To ERP, e – CRM, SCM, RE – Engineering, WTO, IPR Etc.	
Total Contact Time: 42 Hours	

Recommended Books

1. Prasad L.M., Principles & Practice Of Management, Sultan Chand & Sons, 8th Edition,2015
2. Banga T. R. &Shrama S.C., Industrial Organisation & Engineering Economics, Khanna Publishers, 25th Edition, 2015
3. Everett E. Adam, Ronald J. Ebert, Production and Operations Management , Prentice Hall of India, 5th edition, 2012
4. Kotler P., Keller K. L, Koshi A.&Jha M., Marketing Management – A South Asian Perspective, Pearson, 14th Edition, 2014
5. TripathiP.C. , Personnel Management & Industrial Relations, Sultan Chand & sons, 21st Edition, 2013
6. Chandra P., Financial management, Tata McGraw Hill, 9th Edition, 2015.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
EC 511: Hardware Description Languages	**3**	**0**	**2**	**4**

Prerequisite

Digital Logic Design

Introduction	**4 Hours**
Basic concepts of Hardware description Languages. Hierarchy, Concurrency, Logic and Delay Modeling. Structural, Data-flow and Behavioural styles of hardware description. Architecture of event driven simulators.	
Syntax and Semantics of VHDL	**12 Hours**
Variable and signal types, arrays and attributes. Operators, expressions and signal assignments. Entities, architecture specification and configurations. Component instantiation. Concurrent and sequential constructs. Use of Procedures and functions, Examples of design using VHDL.	
Syntax and Semantics of Verilog	**16 Hours**
Basics: What is Synthesis?, Synthesis in a Design Process, Logic Value System, Bit-Widths, Value Holders for Hardware Modeling Verilog Constructs to Gates: Continuous Assignment Statement, Procedural Assignment Statement, Logical Operators, Arithmetic Operators, Relational Operators, Equality Operators, Shift Operators, Vector Operations, Part-Selects, Bit-Selects, Conditional Expression, Always Statement, If Statement, Case Statement, More on Inferring Latches, Loop Statements, Modeling Flip-Flops, More on Blocking vs Non-blocking Assignments, Functions, Tasks, Using Values x and z, Gate Level Modeling, Module Instantiation Statement, Parameterized Designs	

Modeling Examples: Modeling Combinational Logic, Modeling Sequential Logic, Modeling a Memory, Writing Boolean Equations, Modeling a FSM, Modeling an Universal Shift Register, Modeling an ALU Examples of design using Verilog, Synthesis of Logic from Hardware Description
Verification **10 Hours** **Synthesis**
Verification: A Test Bench, Delays in Assignment Statements, Unconnected Ports, Missing Latches, More on Delays, Event List, Synthesis Directives, Variable Asynchronous Preset, Blocking and Non-Blocking Assignments Synthesis
Total Contact Time: 42 Hours

Recommended Books
1. J. Bhaskar, "VHDL Primer", Pearson Education Asia 2001. 2. Z. Navabi, "VHDL", McGraw Hill International Ed. 1998. 3. S. Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Prentice Hall NJ, USA), 1996. 4. J. Bhaskar, "Verilog HDL Synthesis - A Practical Primer", Star Galaxy Publishing,(Allentown, PA) 1998.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
CS 511: Numerical Methods using Python	**3**	**0**	**2**	**4**

Prerequisite
General Information Core Python: Variables, Strings, Tuples, Lists, Arithmetic Operators, Comparison Operators, Conditionals, Loops, Type Conversion, Math Functions, Reading I/P, Printing O/P, Error Control Functions and Modules: Functions, Modules Mathematics Modules: math Module, cmathModulenumarray Module: General Information, Creating an Array, Accessing & Changing Array Elements, Operations on Arrays, Array Functions, Copying Arrays, Scoping of Variables, Writing and Running Programs.

Systems of Linear Algebraic Equations	**10 Hours**
Introduction: Notation, Uniqueness of Solution, III-Conditioning, Linear Systems, Method of Solution, Overview of Direct Methods. Gauss Elimination Method: Introduction, Algorithm for Gauss Elimination Method, Multiple Sets of Equation. LU Decomposition Methods: Introduction, Doolittle's Decomposition, Choleski's Decomposition Pivoting: Introduction, Diagonal Dominance, Gauss Elimination with Scaled Row Pivoting, When to Pivot. Matrix Inversion. Iterative Methods: Introduction, Gauss-Seidel Method	
Interpolation, Curve Fitting and Roots of Equations	**12 Hours**
Introduction, Polynomial Interpolation: Lagrange's Method, Newton's Method, Neville's Method, Limitations of Polynomial Interpolation. Interpolation with Cubic Spline. Introduction, Incremental Search Method, Method of Bisection, Brent's Method, Newton-Raphson Method.	
Numerical Differentiation	**10 Hours**

Introduction, Finite Difference Approximations: First Central Difference Approximations, First Non-Central Finite Difference Approximations, Second Non-Central Finite Difference Approximations, Errors in Finite Difference Approximations. Richardson Extrapolation, Derivatives by Interpolation: Polynomial Interpolant, Cubic Spline Interpolant.
Numerical Integration **10 Hours**
Introduction, Newton-Cotes Formulas: Trapezoidal Rule, Composite Trapezoidal Rule, Recursive Trapezoidal Rule, Simpson's Rules. Romberg Integration, Gaussian Integration: Gaussian Integration Formulas, Orthogonal Polynomials, Determination of Nodal Abscissas and Weights, Abscissas and Weights for Classical Gaussian Quadrature.
Total Contact Time: 42 Hours

Recommended Books
1. J. Klusalaas, "Numerical Methods in Engineering with Python", Cambridge University Press.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
CS 512: Probabilistic Graphical Model	**3**	**0**	**2**	**4**
Prerequisite				
Probability Theory, Statistics, Basic Programming, Algorithm Design and Analysis				

Introduction **10 Hours**
Motivation, Structured Probabilistic Models, Overview and Roadmap, Probability Theory, Graphs. Bayesian Networks: Exploiting Independence Properties, Bayesian Networks, Independencies in Graphs, From Distributions to Graphs. Undirected Graphical Models: The Misconception Example, Parameterization, Markov Network Independencies, Parameterization Revisited, Bayesian Networks and Markov Networks, Partially Directed Models.
Learning Graphical Models and Exact Inference (Variable Elimination) **10 Hours**
Learning Graphical Models: Motivation, Goals of Learning, Learning as Optimization, Learning Tasks. Parameter Estimation: Maximum Likelihood Estimation, MLE for Bayesian Networks, Bayesian Parameter Estimation, Bayesian Parameter Estimation in Bayesian Networks, Learning Models with Shared Parameters, Generalization Analysis. Exact Inference (Variable Elimination): Analysis of Complexity, Variable Elimination, complexity and Graph Structure. Exact Inference (Clique Trees): Variable Elimination and Clique Trees, Message Passing (Sum Product), Message Passing (Belief Update), Constructing a Clique Tree.
Particle-Based Approximate Inference and MAP Inference **10 Hours**
Particle-Based Approximate Inference: Forward Sampling, Likelihood Weighting and Importance Sampling, Markov Chain Monte Carlo Methods, Collapsed Particles, Deterministic Search Methods. MAP Inference: Overview, Variable Elimination for (Marginal) MAP, Max-Product in Clique Trees, Max Product Belief Propagation in Loopy Cluster Graphs, MAP as a Linear Optimization Problem, Using Graph Cuts for MAP.
Partially Observed Data and the Exponential Family **12 Hours**

Partially Observed Data: Foundations, Parameter Estimation, Bayesian Learning with Incomplete Data, Structure Learning, Learning Models with Hidden Variables. Learning Undirected Models: Overview, The Likelihood Function, Maximum (Conditional) Likelihood Parameter Estimation, Parameter Priors and Regularization, Learning with Approximate Inference, Structure Learning.The Exponential Family: Introduction, Exponential Families, Factored Exponential Families, Entropy and Relative Entropy, Projections. Inference as Optimization: Introduction, Exact Inference as Optimization, Propagation Based Approximation, Propagation with Approximate Messages, Structured Variational Approximation.
Total Contact Time: 42 Hours

Recommended Books
1. Probabilistic Graphical Models: Principles and Techniques by Daphne Koller and Nir Friedman. MIT Press. 2. Modelling and Reasoning with Bayesian networks by Adnan Darwiche. 3. Pattern Recognition and Machine Learning by Chris Bishop. 4. Machine Learning: a Probabilistic Perspective by Kevin P. Murphy. 5. Information Theory, Inference, and Learning Algorithms by David J. C. Mackay. 6. Bayesian Reasoning and Machine Learning by David Barber. 7. Graphical models, exponential families, and variational inference by Martin J. Wainwright and Michael I. Jordan. 8. http://www.cs.cmu.edu/~epxing/Class/10708-14/lecture.html. 9. https://cs.stanford.edu/~ermon/cs228/index.html. 10. https://ermongroup.github.io/cs228-notes. 11. http://people.csail.mit.edu/dsontag/courses/pgm13.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
EC 521: Sensors and Instrumentation	**3**	**0**	**0**	**3**

Measurement Instrumentation	**8 Hours**
General introduction and Definitions, The historical aspects of measurement, Terminology: measurement, instrumentation and metrology, MIM interactions: measurement-instrumentation-metrology, Instrumentation, Classification of instruments, Instrument modelling, Characteristics of an instrument, Implementing measurement acquisition, Analysing measurements obtained by an instrument, Electronic instrumentation, Electronic instrumentation functionality, The role of instrumentation in quality control.	
General Principles of Sensors Transducers	**10 Hours**
Definitions of important terms, Metrological characteristics of sensors, Sensor calibration, Band pass and response time, Passive sensor conditioners, Conditioners for active sensors. Classification of Transducers, Selecting a Transducer, Strain Gages, Displacement Transducers, Temperature Measurements, Photosensitive Devices, Magnetic Measurements.	
DC and AC Bridges and their applications	**10 Hours**
Introduction, Wheatstone bridge, Sensitivity of Wheatstone bridge, The Kelvin Bridge, The	

Megohm bridge and measurement of very high resistances. The general equations for bridge balance, Inductance and Capacitance Comparison Bridges, The Maxwell bridge, The Hay's bridge, The Schering bridge, The RC Frequency Bridge (Wein Bridge), The Wagner Ground Connection, Shielding of Bridge Elements, The Universal Impedance Bridge.

Sensors Applications, Smart Sensors based networks	**14 Hours**

Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Medical Diagnostic Sensors, Sensors for Environmental Monitoring. Smart sensors fundamentals: Basic sensor technology Sensor systems; Smart sensors definitions, Characteristics; Smart sensors architectures; Smart sensors buses and interfaces; Smart sensors software; Data acquisition methods for smart sensors; Virtual sensor systems; Smart sensors for electrical and non-electrical variables. Sensor networks architectures: Single node architecture; Multi node architectures; Design principles; Energy efficient topologies; Wired sensor networks and wireless sensor networks; Application examples, Nano Sensors, Biosensors.

Total Contact Time: 42 Hours

Recommended Books

1. Patranabis D., "Sensors and Transducers", Prentice-Hall India, 2nd Ed., 2004
2. Ramon Pallas & John G. Webster, "Sensors & Signal Conditioning", John Wiley & Sons, 2nd Ed.
3. Webster John G., "Instrumentation and Sensors Handbook", CRC Press, 1st Ed., 1999.
4. Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs & Applications", Springer, 3rd Ed.
5. Shawhney A. K., "Electrical & Electronics Measurements &Instrumentation", Dhanpat Rai & Sons.
6. N. V. Kirianaki, S. Y. Yurish, “Data Acquisition & Signal Processing for Smart Sensors”, John Willey.
7. H. Karl, A. Willig, N. O. Shpak, “Protocols & Architectures for WSN”, John Wiley
8. M. Ilyas, I. Mahgoub, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems”, CRC.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
CS 521: Fuzzy Logic And Neural Networks	**3**	**0**	**0**	**3**

Fuzzy Sets and Fuzzy Relations, Fuzzy Inference Systems and Fuzzy Clustering	**12 Hours**

Introduction, Classic sets, fuzzy sets, crisp relations, fuzzy relations, tolerance and equivalence relations. membership function, fuzzification, fuzzy inference, defuzzification methods, fuzzy logic controller, fuzzy c-means clustering, applications of fuzzy logic, fuzzy tolerance and equivalence relations, value assignments.

Properties of Membership Functions, Fuzzification, and Defuzzification, Logic and Fuzzy Systems	**10 Hours**

Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-cuts for Fuzzy Relations, Defuzzification to Scalars. Classical logic, Fuzzy logic, Fuzzy systems, Natural Language, Linguistic Hedges, Fuzzy (Rule-Based) Systems, Graphical Techniques of Inference.

Automated Methods for Fuzzy Systems, Development of Membership Functions	**10 Hours**
Definitions, batch least squares algorithm, recursive least squares algorithm, gradient method, clustering method, learning from example, modified learning from example. Membership value assignments, intuition, inference, rank ordering, neural networks, genetic algorithms, inductive reasoning.	
Introduction to Neural Networks and Learning Processes	**10 Hours**
What is neural network? human brain and biological neuron, model of an artificial neuron, activation functions, neural network architectures, artificial intelligence and neural networks. What is learning?, types of learning: supervised, unsupervised and reinforcement learning, basic learning rules: error correction learning, memory-based learning, habbian learning, competitive learning, Boltzmann learning, learning tasks.	
Total Contact Time: 42 Hours	

Recommended Books

1. Simon Haykin, "Neural Networks – A comprehensive Foundation", Pearson Education, 1999.
2. T.J.Ross, "Fuzzy Logic with Engineering Applications", Wiley, 2005.
3. S. Rajasekaran, and G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications", PHI, New Delhi, 2004.
4. D.K.Pratihar, "Soft Computing", Narosa Publication House, 2008.
5. J.R.Jang, C. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence", PHI, New Delhi, 2012.
6. J. M. Zurada, "Introduction to Artificial Neural Systems", West Publishing Company, 1992.
7. Bart Kosko, "Neural Networks and Fuzzy Systems: A dynamical systems approach to machine intelligence", PHI, 1997.
8. H. J. Zimmermann, "Fuzzy Set Theory & its Applications", 2nd Ed., Kluwer Academic, 1991.

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
CS 522: Human Computer Interface	**3**	**0**	**0**	**3**

Prerequisite
Basics of Programming

Foundations of Human-Computer Interaction **The Design Process**	**12 Hours**
Introduction to Human-Computer Interaction, Human Capabilities, The Computer, The Interaction, Paradigms Interaction Design Basics, HCI in the Software Process, Design Rules, Universal Design	
Implementation Support **Evaluation and User Support**	**8 Hours**
Implementation Tools Evaluation, User Support	
Users Models	**10 Hours**

Task Models and Dialogs	
Cognitive Models Socio-organizational Issues and Stakeholder Requirements Analyzing Tasks Dialog Notations and Design	
Groupware **Ubiquitous Computing** **Virtual and Augmented Reality** **Hypertext and Multimedia**	**12 Hours**
Groupware and Computer-supported Collaborative Work Ubiquitous Computing Virtual Reality and Augmented Reality Hypertext, Multimedia and the World Wide Web	
Total Contact Time: 42 Hours	

Recommended Books
1. Dix A. et al., Human-Computer Interaction. Harlow, England: Prentice Hall, 2004, ISBN-10: 0130461091 2. Preece, J., Rogers, Y., & Sharp, H. (2015). Interaction design: Beyond human computer interaction (4th ed.) John Wiley & Sons Ltd. ISBN 978-1-119-02075-2 3. Yvonne Rogers, Helen Sharp, Jenny Preece, Interaction Design: Beyond Human Computer Interaction, 3rd Edition, Wiley, 2011, ISBN-10: 0470665769 4. https://hci.stanford.edu/courses/cs147/2012/ 5. https://www.athabascau.ca/syllabi/comp/comp482.php 6. http://www2.sta.uwi.edu/~anikov/comp3220/syllabus.htm

B.TECH. III Semester-5	**L**	**T**	**P**	**C**
CS 524: Object Oriented Programming	**3**	**0**	**0**	**3**

Prerequisite
Fundamentals of Computer Programming

Introduction to JAVA	**8 Hours**
Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java	
Objects and Classes	**8 Hours**
Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, String Buffer, File, this reference.	
Inheritance and Polymorphism	**8 Hours**
Inheritance in java, Super and sub class, Overriding, Object class, Polymorphism, Dynamic binding,	

Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package	
Event and GUI programming	**10 Hours**
Event handling in java, Event types, Mouse and key events, GUI Basics, Panels, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, Text Fields, Text Areas, Combo Boxes, Lists, Scroll Bars, Sliders, Windows, Menus, Dialog Box, Applet and its life cycle, Introduction to swing	
I/O Programming **Multithreading in JAVA**	**8 Hours**
Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files Thread life cycle and methods, Runnable interface, Thread synchronization, Exception handling with try-catch-finally, Collections in java, Introduction to JavaBeans and Network Programming	
Total Contact Time: 42 Hours	

Recommended Books

1. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson.
2. Programming in Java, Sachin Malhotra &Saurabh Chaudhary, Oxford University Press.
3. Murach's Beginning Java 2, Doug Lowe, Joel Murach and Andrea Steelman, SPD.
4. Core Java Volume-I Fundamentals, Eight Edition, Horstmann& Cornell, Pearson Education.
5. The Complete Reference, Java 2 (Fourth Edition), Herbert Schild, TMH.