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| B.TECH. III Semester-5 | L | T | P | C |
| CS 501: Software Engineering | 3 | 0 | 2 | 4 |

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| Introduction to Software Design and Analysis | 12 Hours |
| Introduction to Software Development Life Cycle Process. Structured Analysis and Structured Design, Object Oriented Analysis and Design. Determining Systems Requirements: Conducting Interviews, Administering Questionnaires. Writing Pseudocode, Data Flow Diagrams (DFD), Entity Relationships modelling (ER), Rapid Application Development (RAD), PERT, CPM. | |
| Overview of Software Engineering | 10 Hours |
| Introduction to Software Project Management. Nature of Software, Software Engineering, Software – process, project, product, Process Models –Classical & Evolutionary models, Overview of System Engineering. Planning – scope, milestones & deliverables, Risk Management, Metrics & MeasurementsModelling – Requirements. | |
| Software Design | 8 Hours |
| Requirements Engineering process– Requirement Elicitation, System Modelling - Requirements Specification and Requirement Validation. Design concepts and principles - Abstraction - Refinement - Modularity – Cohesion & coupling, Architectural design, Detailed Design – Transaction & Transformation, Refactoring of designs, Object-oriented Design User-Interface Design. | |
| Validation & Verification | 12 Hours |
| Quality Assurance | |
| <u>Validation & Verification</u> Software Evolution Strategic Approach to Software Testing, Testing Fundamentals – Test Plan, Test Design, Test Execution, Reviews, Inspection & Auditing. Software Maintenance, Types of Maintenance, Software Configuration Management, Overview of RE-engineering & Reverse Engineering. | |
| <u>Quality Assurance</u> Recent Trends, Product & Process Metrics, Quality Standards & Models –ISO, TQM, Six- Sigma Recent Trends in Software Design/Specialized Software Testing, Related Tools and Standards. | |
| Total Contact Time: 42 Hours | |

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| Recommended Books |
| <ol style="list-style-type: none"> 1. Roger Pressman, "Software Engineering: A Practitioner's Approach", 7th Edition, McGraw-Hill, 2010. 2. Ian Sommerville, "Software Engineering", 9th Edition, Addison-Wesley, 2016. 3. Jeffery A. Hoffer, Joey F. George, & Joseph S. Valacich, Third Edition, Modern Systems Analysis and Design, Pearson Education, 2003 4. Pankaj Jalote, "A Concise Introduction to Software Engineering", Springer, 2008. 5. William E. Lewis, "Software Testing and Continuous Quality Improvement", Third Edition, Auerbach Publications, 2008. |

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| B.TECH. III Semester-5 | L | T | P | C |
| CS 502: Computer Graphics | 3 | 0 | 2 | 4 |

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| Graphics primitives | 10 Hours |
| Coordinate representation, Pixel, Raster Scan & Random Scan methods; Color CRT Raster Scan Basics, Video Basics, Interactive, Graphics Input and Output Devices. Image Formation, Image Representation and Modeling, Overview of Image and Graphics Applications, Vector graphics, Coordinates, points, lines and polygons: Coordinate systems, Geometric shapes using Graphics Libraries. Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan- line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributers. | |
| 2D-3D transformations | 10 Hours |
| Transformations (Scaling, Rotation, Translation), Combined Transformations; Homogeneous coordinates, 3-D representation, Solid Body transformations, Projections: Perspective, Orthographic, Axonometric, Oblique projections, 2-D, 3-D dimensional transformations, perspective transformations using Graphics Libraries. | |
| Clipping | 10 Hours |
| 2-D Clipping, Sutherland-Cohen subdivision Line Clipping algorithm, Mid-point subdivision algorithm, 3- D Clipping, 3-D Mid-point subdivision algorithm; Polygon Clipping, Sutherland-Hodgman algorithm; Character Clipping, clipping functions using Graphics Libraries. | |
| Modeling, Rendering and Advance Topics | 12 Hours |
| Modeling: Polygonal meshes, Spline & subdivision surfaces, Volumetric Representations Rendering: Lighting models, Global Illumination, Visibility, Image-based rendering, Animation: Kinematics, Passive dynamics, Active dynamics. Hidden lines & hidden surface removal algorithms, Color, Additive and Subtractive picture representation, Shading, Shadows, Texture and Ray Tracing, Fractals, Half-toning, Anti-aliasing methods. | |
| Total : 42 Hrs | |

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| Recommended Books |
| <ol style="list-style-type: none"> 1. Donald Hearn & M. Pauline Baker, "Computer Graphics", Pearson Education, 3/E, 2004 2. David F Rogers, "Procedural Elements for Computer Graphics", TMH International Ed, 2001. 3. David F Rogers, "Mathematical Elements for Computer Graphics", TMH International Ed, 2002. 4. F. S. Hill, Jr., "Computer Graphics using OpenGL", 2/E, Pearson Education, Reprint 2005. 5. James D. Foley, "Computer Graphics: Principles and Practice", by Addison-Wesley. |

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

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| Introduction | 10 Hours |
| Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) | |
| 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-2 Decimation 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 | |

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| Recommended Books |
| <ol style="list-style-type: none"> 1. John G. Proakis & Dimitris K. Manolakis, "Digital Signal Processing", 4th Edition, Prentice Hall. 2. Alan V. Oppenheim & Ronald W. Schaffer, "Discrete-Time Signal Processing", 3rd Edition, PHI. 3. Sanjit Mitra, "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. |

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

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| 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 |
| <i>Marketing Management:</i> 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 | |
| <i>Operations Management:</i> Introduction To Operations Management, Types Of Operation Systems, Types Of Layouts, Material Handling, Purchasing & Store System, Inventory Management | |
| <i>Personnel Management:</i> Roles & Functions Of Personnel Manager, Recruitment, Selection, Training, Industrial Dispute, Collective Bargaining | |
| <i>Financial Management:</i> 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 | |

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| Recommended Books |
| <ol style="list-style-type: none"> 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. Tripathi P.C. , Personnel Management & Industrial Relations, Sultan Chand & sons, 21st Edition, 2013 6. Chandra P., Financial management, Tata McGraw Hill, 9th Edition, 2015. |

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

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| Prerequisite |
| Digital Logic Design |

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| 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 Synthesis | 10 Hours |
| 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 | |

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| 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. |

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

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

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| Systems of Linear Algebraic Equations | 10 Hours |
| <p>Introduction: Notation, Uniqueness of Solution, Ill-Conditioning, Linear Systems, Method of Solution, Overview of Direct Methods.</p> <p>Gauss Elimination Method: Introduction, Algorithm for Gauss Elimination Method, Multiple Sets of Equation.</p> <p>LU Decomposition Methods: Introduction, Doolittle's Decomposition, Choleski's Decomposition</p> <p>Pivoting: Introduction, Diagonal Dominance, Gauss Elimination with Scaled Row Pivoting, When to Pivot. Matrix Inversion. Iterative Methods: Introduction, Gauss-Seidel Method</p> | |
| Interpolation, Curve Fitting and Roots of Equations | 12 Hours |
| <p>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.</p> | |
| Numerical Differentiation | 10 Hours |
| <p>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.</p> | |
| Numerical Integration | 10 Hours |
| <p>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.</p> | |
| Total Contact Time: 42 Hours | |

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

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| 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 | | | | |

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| 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 | |

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| Recommended Books |
| <ol style="list-style-type: none"> 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. |

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

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| 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 | |

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| Recommended Books |
| <ol style="list-style-type: none"> 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. |

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

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| 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 | |

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| Recommended Books |
| <ol style="list-style-type: none"> 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. |

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

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| Prerequisite |
| Basics of Programming |

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| 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 Task Models and Dialogs | 10 Hours |
| 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 | |

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| 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 |

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| B.TECH. III Semester-5 | L | T | P | C |
| CS 523: Game Theory | 3 | 0 | 0 | 3 |

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| Non cooperative Game Theory | 10 Hours |
| Introduction to Game Theory, Extensive Form Games, Strategic Form Games, Dominant Strategy Equilibria, Pure Strategy Nash Equilibrium, Mixed Strategy Nash Equilibrium, Von Neumann - Morgenstern Utility Theory, Rationalizable Strategies, Sperner's Lemma, Fixed Point Theorems, and Existence of Nash Equilibrium, Computation of Nash Equilibrium, Complexity of Computing Nash Equilibrium, Matrix Games (Two Player Zerosum Games). | |
| Bayesian Games Mechanism Design - 1 | 10 Hours |
| Bayesian Games, Subgame Perfect Equilibrium. Introduction to Mechanism Design, Social Choice Functions and Mechanisms, Incentive Compatibility and Revelation Theorem, Properties of Social Choice Functions, Gibbard Satterthwaite Theorem and Arrow Impossibility Theorem, Mechanism Design -- Tutorial (Part 1). | |
| Mechanism Design - 2 | 10 Hours |
| Quasilinear Mechanisms, Vickrey-Clarke-Groves Mechanisms, Bayesian Incentive Compatible Mechanisms, Revenue Equivalence Theorem, Optimal Auctions and Myerson Auction, Case Study: Sponsored Search Auctions, Other Topics in Mechanism Design. Mechanism Design -- Tutorial (Part 2) | |
| Cooperative Game Theory | 12 Hours |
| Correlated Strategies and Correlated Equilibrium, The Two Person Bargaining Problem, Coalitional Games, The Core, The Shapley Value, Other Concepts (Stable Sets, Bargaining Sets, Kernel, Nucleolus, Gately Point). | |
| Total Contact Time: 42 Hours | |

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| Recommended Books |
| <ol style="list-style-type: none"> 1. An Introduction to Game Theory, by Martin J. Osborne, Oxford University Press, USA (August 1, 2003) 2. Games of Strategy, Second Edition, by Avinash K. Dixit and Susan Skeath, W. W. Norton & Company; 2 edition (April 2004) 3. Eichberger, J. (1993). Game Theory for Economists, Academic Press, San Diego. 4. Fudenberg, D., Tirole, J. (1991). Game Theory, MIT Press, Cambridge, Massachusetts. 5. Osborne, M., Rubinstein, A. (1994). A Course in Game Theory, MIT Press, Cambridge, Massachusetts. 6. Mas-Collel, A., Whinston, M. D., Green, J. R. (1995). Microeconomic Theory, Oxford University Press, New York, Oxford. (Chapters 13, 14) 7. http://lcm.csa.iisc.ernet.in/gametheory/index.html. |