**AC 27/2/13 Item no. 4.123**

# University of Mumbai


# Program: M. Sc.

# Course: Computer Science

# Semester – III and IV

(Credit Based Semester and Grading System with effect from the academic year 2013 - 14)

## 1. Course Structure & Distribution of Credits.

This CBGS MSc Computer Science syllabus of Semester III and IV is an extension of the existing syllabus CBGS MSc Part I (Semester I and II) syllabus implemented from the academic year 2012 – 13. It is currently being taught at MSc Computer Science Semester III and IV of University of Mumbai for the last few years, but modified to be placed within the credit based grading system to be implemented from the academic year 2013 – 2014. However, there are few changes incorporated in the existing syllabus based on the feedback of the teaching and student community as well as to incorporate recent trends.

The syllabus proposes **four papers and Project Based Learning Component consisting of a project to be done in Semester IV.** Each Paper in Semester III and IV has theory as well as practical component consisting of 4 credits for theory and 2 credits practical.

Thus, Semester III is of 24 credits. Semester IV has an additional Component of project having 6 credits. Thus Semester IV has in all 30(24+6) credits. Each of the theory courses has four units and is expected to cover in 60 lectures period. Each of the practical courses is of 60 hours.

**Revised Syllabus of M.Sc. Computer Science**
**(Based on Credit and Grading System)**

| **Semester III** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Theory Course** | | | **Practical Course** | | |
| **Theory Paper Code** | **Paper Nomenclature** | **Lectures** | **Credits** | **Practical Paper Code** | **Hours** | **Credits** | **Total** |
| PSCS301 | Artificial Intelligence | 60 | 04 | PSCSP301 | 60 | 02 | 06 |
| PSCS302 | Distributed Computing | 60 | 04 | PSCSP302 | 60 | 02 | 06 |
| | **Elective I (Select ONE** | 60 | 04 | | 60 | 02 | 06 |
| PSCS3031 | Parallel Processing | | | PSCSP3031 | | | |
| PSCS3032 | System Security | | | PSCSP3032 | | | |
| PSCS3033 | Enterprise Networking | | | PSCSP3033 | | | |
| PSCS3034 | Fuzzy Logic and Neural | | | PSCSP3034 | | | |
| PSCS3035 | Natural Language | | | PSCSP3035 | | | |
| | **Elective II (Select ONE** | 60 | 04 | | 60 | 02 | 06 |
| PSCS3041 | Pattern Recognition | | | PSCSP3041 | | | |
| PSCS3042 | Virtual Reality and Virtual Environment | | | PSCSP3042 | | | |
| PSCS3043 | Bio Informatics | | | PSCSP3043 | | | |
| PSCS3044 | Optimization Techniques | | | PSCSP3044 | | | |
| PSCS3045 | Principles of Robotics Programming – I | | | PSCSP3045 | | | |
| **Total** | | | **16** | | **Total** | **08** | **24** |

| Semester IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Theory Course** | | | **Practical Course** | | |
| **Theory Paper Code** | **Paper Nomenclature** | **Lectures** | **Credits** | **Practical Paper Code** | **Hours** | **Credits** | **Total** |
| PSCS401 | Image Processing | 60 | 04 | PSCSP401 | 60 | 02 | 06 |
| PSCS402 | Embedded Systems | 60 | 04 | PSCSP402 | 60 | 02 | 06 |
| | **Elective I (Select ONE from)** | 60 | 04 | | 60 | 02 | 06 |
| PSCS4031 | Embedded Systems | | | PSCSP4031 | | | |
| PSCS4032 | Information Security | | | PSCSP4032 | | | |
| PSCS4033 | Satellite Communication | | | PSCSP4033 | | | |
| PSCS4034 | Multimedia Systems and convergence to technologies | | | PSCSP4034 | | | |
| PSCS4035 | Natural Language Processing-II | | | PSCSP4035 | | | |
| | **Elective II (Select ONE from)** | 60 | 04 | | 60 | 02 | 06 |
| PSCS4041 | Computer Vision | | | PSCSP4041 | | | |
| PSCS4042 | Java Technology | | | PSCSP4042 | | | |
| PSCS4043 | Intelligent System | | | PSCSP4043 | | | |
| PSCS4044 | Customer Relationship Management | | | PSCSP4044 | | | |
| PSCS4045 | Principles of Robotics Programming – II | | | PSCSP4045 | | | |
| PSCSPR405 | Project Work | | | | 100 | 06 | 06 |
| | | **Total** | **16** | | **Total** | **14** | **30** |

# M.Sc. Computer Science
# Semester III

| Course Code | Title | Credits |
|---|---|---|
| **PSCS301** | **Artificial Intelligence [60 Lectures]** | **04** |

**Unit I: AI and Internal Representation: [15 L]**

Artificial Intelligence and the World, Representation in AI, Properties of Internal Representation, The Predicate Calculus, Predicates and Arguments, Connectives Variables and Quantification, How to Use the Predicate Calculus, Other Kinds of Inference Indexing, Pointers and Alternative Notations, Indexing, The Isa Hierarchy, Slot-Assertion Notation, Frame Notation.

**AI language: Lisp**

Lisps, Typing at Lisp, Defining Programs, Basic Flow of Control in Lisp, Lisp Style, Atoms and Lists, Basic Debugging, Building Up List Structure, More on Predicates, Properties, Pointers, Cell Notation and the Internals (Almost) of Lisp, Destructive Modification of Lists, The for Function ,Recursion, Scope of Variables, Input/ Output, Macros

**UnitII: Introduction to Neural and fuzzy Systems [15 L]**

Neural and fuzzy machine Intelligence, The Dynamical Systems approach to Machine Intelligence, The brain as a dynamical system, Neural and fuzzy systems as function Estimators, Intelligent Behavior as Adaptive Model free Estimation, Generalization and creativity, Learning as change, Symbol vs Numbers, Rules vs Principles, Expert system Knowledge as rule trees, Symbolic vs Numeric Processing.

**Fuzzy systems**

Fuzziness as Multivalence, Fuzzy systems as Structured Numerical estimators, Generating Fuzzy rules with product space Clustering, Fuzzy Systems as Parallel associators, Fuzzy systems as Principle based Systems, Fuzzy systems and applications,

**Neural Network Theory**

Neuronal Dynamics: Neural Networks as trainable Dynamical system, Activations and signals**,** Neurons as functions, signal monotonicity, Biological Activations and signals, Neuron Fields, Neuron Dynamical Systems, Common signal functions, Pulse-Coded Signal functions

**Unit III: Genetic Algorithms [15 L]**

A simple genetic algorithm, A simulation by hands, similarity templates(Schemata), Mathematical foundations, Schema Processing at work, The two- armed and k-armed Bandit Problem, The building block hypothesis, The minimal Deceptive Problem

Computer implementation of Genetic algorithm, Data Structures, Reproduction , Cross over and Mutation, Time to reproduce and time to Cross Mapping objective function to fitness form, Fitness scaling

Applications of genetic algorithm, De Jong and Function Optimization, Improvement in basic techniques, Introduction to Genetics based machine learning, applications of genetic based machine leaning

**Unit IV: Data Mining** **[15 L]**

Introduction to Data Mining, Computer systems that can learn, Machine learning and methodology of science, Concept learning, Data ware house, designing decision support systems, Client server and data warehousing, Knowledge Discovery Process, Visualization Techniques, K- nearest neighbor, Decision trees, OLAP tools, Neural networks, Genetic algorithm, Setting up a KDD environment, Real life applications, Customer profiling, Discovering foreign key relationships.

**References:**


1. Introduction to Artificial Intelligence By Eugene Charniak, Drew McDermott- Addison Wesley
2. Neural Networks and fuzzy systems A dynamical systems approach to machine Intelligence by Bart Kosko- PHI
3. Genetic Algorithms in search, Optimization & Machine Learning by David E Goldberg-Addison wesley
4. Data Mining by Pieter Adriaans and Dolf Zantinge – Pearson Education Asia
5. Data Warehousing in the Real World by Sam Anahory and Dennis Murray, Addison –Wesley.


| Course Code | Title | Credits |
|---|---|---|
| **PSCS302** | **Distributed Computing** **[60 Lectures]** | **04** |

**Unit I:** **[15 L]**

**Introduction to Distributed System:** Goals, Hardware concepts, Software concepts, and Client-Server model. Examples of distributed systems.

**Communication:** Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication.

**Processes:** Threads, Clients, Servers, Code Migration, Software agent.

**Unit II:** **[15 L]**

**Naming:** Naming entities, Locating mobile entities, Removing un-referenced entities.

**Synchronization:** Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions.

**Unit III:** **[15 L]**

**Consistency and Replication:** Introduction, Data centric consistency models, Client centric consistency models, Distribution protocols, Consistency protocols.

**Fault Tolerance:** Introduction, Process resilience, Reliable client server communication, Reliable group communication. Distributed commit, Recovery.

**Unit IV:** **[15 L]**

**Security:** Introduction, Secure channels, Access control, Security management.

**Distributed File System:** Sun network file system, CODA files system.

**Case Study:** CORBA, Distributed COM, Globe, Comparison of CORBA, DCOM, and Globe.

**Text Books:**


1. A. Taunenbaum, **"***Distributed Systems: Principles and Paradigms***"**
2. G. Coulouris, J. Dollimore, and T. Kindberg, "*Distributed Systems: Concepts and Design*", Pearson Education


**References:**


**1.** M. Singhal, N. Shivaratri, "*Advanced Concepts in Operating Systems*", TMH

**Electives I**
**Select any ONE from PSCS3031 TO PSCS3035**

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3031** | **Parallel Processing [60 Lectures]** | **04** |

**Unit I: [15 L]**

**Introduction:** Parallel Processing Architectures: Parallelism in sequential machines, Abstract model of parallel computer, Multiprocessor architecture, Pipelining, Array processors.

**Programmability Issues:** An overview, Operating system support, Types of operating systems, Parallel programming models, Software tools

**Data Dependency Analysis:** Types of dependencies loop and array dependences, Loop dependence analysis, Solving diophantine equations, Program transformations

**Unit II: [15 L]**

**Shared Memory Programming:** General model of shared memory programming, Process model under UNIX

**Algorithms for Parallel Machines:** Speedup, Complexity and cost, Histogram computation, Parallel reduction, Quadrature problem, Matrix multiplication, Parallel sorting algorithms, Solving linear systems, Probabilistic algorithms

**Unit III:**
**[15 L]**

**Message Passing Programming:** Introduction, Model, Interface, Circuit satisfiability, Introducing collective, Benchmarking parallel performance

**Parallel Programming languages:** Fortran90, nCUBE C, Occam, C-Linda

**Debugging Parallel Programs:** Debugging techniques, Debugging message passing parallel programs, Debugging shared memory parallel programs.

**Unit IV: [15 L]**

**Memory and I/O Subsystems:** Hierarchical memory structure, Virtual memory system, Memory allocation and management, Cache allocation and management, Cache memories and management, Input output subsystems

**Other Parallelism Paradigms:** Data flow computing, Systolic architectures, Functional and logic paradigms, Distributed shared memory

**Performance of Parallel Processors:** Speedup and efficiency, Amdahl's law, Gustafson-Barsis's law, Karf-Flatt metric, Isoefficiency metric

**Text Books:**


1. Hawang Kai and Briggs F. A., "*Computer Architecture and Parallel Processing"*, McGraw Hill
2. Jorden H. F. and Alaghaband G., "*Fundamentals of Parallel Processing*"
3. M.J. Quinn, "*Parallel Programming*", TMH


**Reference Books:**


1. Shasikumar M., "*Introduction to Parallel Processing"*, PHI
2. Wilson G.V., "*Practical Parallel Programming*", PHI
3. D. E. Culler, J.P. Singh, A. Gupta, "*Parallel Computer Architecture*", Morgan Kaufman

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3032** | **System Security [60 Lectures]** | **04** |

**Unit I: [15 L]**

**Introduction:** Notion of different types of securities: Information Security.

**Computer Security:** Security Goals, Relation between Security-Confidentiality, Integrity, Availability and Authorization, Vulnerabilities- Principles of Adequate protection. Operating security, Database security, Program security, Network Security (Notions Only).

**Attacks:** Threats, Vulnerabilities and controls. The kind of problems-Interception, Interruption, Modification, Fabrication.

**Computer Criminals:** Amateurs, Crackers, Career Criminals. Methods of Defense: Control, Hardware Controls, Software Controls, Effectiveness of Controls.

**Program Security:** Secure programs: Fixing Faults, Unexpected Behaviour, Types of Flaws. **Non-malicious program errors:** Buffer overflows, Incomplete Mediation. Viruses and other

**Malicious code:** Why worry about Malicious Code, Kinds of malicious code, How viruses attach, How viruses gain control, Prevention,

**Control Example:** The Brain virus, The Internet Worm, Web bugs.

**Targeted malicious code**: Trapdoors, Salami Attack.

**Controls against program threats:** Development Controls, Peer reviews, Hazard Analysis.

**Unit II: [15 L]**

**Operating System Security:** Protected objects and methods of protection

**Memory address protection**: Fence, Relocation, Base/Bounds Registers, Tagged Architecture, Segmentation, Paging.

**Control of access to general objects:** Directory, Access Control List.

**File protection mechanism**: Basics forms of Protection, Single Permissions.

**Authentication:** Authentication basics, Password, Authentication Process Challenge-response, Biometrics.

**Trusted Operating systems**: Security Policies for Operating Systems,

**Models of Security**: Requirement of security systems, Multilevel Security, Access Security, Limitations of Security Systems.

***Trusted Operating System Design***: Elements, security features, assurance, system flaws and assurance methods.

**Unit III: [15 L]**

**Database Security:** Security requirements- Integrity of Database, Confidentiality and Availability, Reliability and integrity, Sensitive data, Interface, Multilevel database, Proposals for multilevel security

**Unit IV:** **[15 L]**

**Administrating Security:**

**Security planning**: Contents of a security , Planning Team members, commitment to a security plan, Business continuity Plans.

**Risk analysis**: The nature of risk, steps of risk analysis. Arguments for and against risk analysis,

**Organizational security policies**: Purpose and goals of Organizational Security. Audience, Characteristics of a Good Security Policy.

**Nature of security Policies**: Data sensitivity policy, Government Agency IT security policy.

**Physical security**: Natural Disaster, Human Vandals, Interception of Sensitive Information

**Legal, Privacy, and Ethical Issues in Computer Security:** Protecting programs and data, Information and law, Rights of employees and employers, Software failures, Computer crime, Privacy, Ethical issues in computer society, Case studies of ethics

**Text Books:**


1. C. P. Pfleeger, and S. L. Pfleeger, "*Security in Computing*", Pearson Education.
2. Matt Bishop, .*Computer Security: Art and Science*., Pearson Education
3. Stallings**, .***Cryptography And Network Security: Principles and practice*.


**Reference:**


1. Whitman, Mattord, .*Principles of information security.*, Thomson


| Course Code | Title | Credits |
|---|---|---|
| **PSCS3033** | **Enterprise Networking [60 Lectures]** | **04** |

**Unit I Introduction to Networks and Data Transmission** **[15 L]**

**Introduction:**

Growth of Computer Networking, Complexity in Network Systems, Mastering the Complexity, Resource Sharing, Growth of the Internet, Probing the Internet, Interpreting A Ping Response

**Transmission Media:**

Copper Wires, Glass Fibers, Radio, Satellites, Geosynchronous Satellites, Low Earth Orbit Satellites, Low Earth Orbit Satellite Arrays, Microwave, Infrared, Light Form a Laser.

**Local Asynchronous Communication:**

The Need for Asynchronous Communication, Using Electric Current to Send Bits, Standards for Communication, Baud Rate, Framing, and Errors, Full Duplex Asynchronous Communication, Limitations of Real Hardware, Hardware Bandwidth and the Transmission of Bits, The Effect of Noise On Communication, Significance for Data Networking.

**Long-Distance Communication (Carriers, Modulation and Modems):**

Sending Signals across Long Distances, Modem Hardware Used for Modulation and Demodulation, Leased Analog Data Circuits, Optical, Radio Frequency, And Dialup Modems, Carrier Frequencies and Multiplexing, Base band And Broadband Technologies, Wave Division Multiplexing, Spread Spectrum, Time Division Multiplexing.

**Unit II: Packet Transmission & LAN Technology** **[15 L]**

**Packets, Frames and Error Detection:**

The Concept of Packets, Packets and Time-Division Multiplexing, Packets and Hardware Frames, Byte Stuffing, Transmission Errors, Parity Bits and Parity Checking, Probability, Mathematics And Error Detection, Detecting Errors With Checksums, Detecting Errors With Cyclic Redundancy Checks, Combining Building Blocks, Burst Errors, Frame format And Error Detection Mechanisms.

**LAN Technologies and Network Topology:**

Direct Point-To-Point Communication, Shared Communication Channels, Significance of LANs and Locality of Reference, LAN Topologies, Bus Network: Ethernet Carrier Sense on Multi-Access Networks (CSMA), Collision Detection and Back off With CSMA/CD, Wireless LANs And CSMA/CA, Bus Network: Local Talk.

**Hardware Addressing and Frame Type Identification:**

Specifying a Recipient, How LAN Hardware Uses Addresses to Filter Packets Format of a Physical Address, Broadcasting, Multicasting, Multicast Addressing, Identifying Packet Contents, Frame Headers And Frame Format, Using Networks That Do Not Have Self-Identifying Frames, Network Analyzers.

**Unit III: Extending LAN** **[15 L]**

**LAN Wiring, Physical Topology, and Interface Hardware:**

Speeds of LANs and Computers, Network Interface Hardware, the Connection between A NIC and A Network, Original Thick Ethernet Wiring, Connection Multiplexing, Thin Ethernet Wiring Twisted Pair Ethernet, the Topology Paradox, Network Interface Cards and Wiring Schemes.

**Extending LANs: Fiber Modems, Repeaters, Bridges and Switches:**

Distance Limitation and LAN Design, Fiber Optic Extensions, Repeaters, Bridges, Frame Filtering Startup and Steady State Behavior of Bridged Networks, Planning a Bridged Network, Bridging Between Buildings, Bridging Across Longer Distances, A Cycle Of Bridges, Distributed Spanning Tree, Switching, Combining Switches And Hubs, Bridging And Switching With Other Technologies.

**Long-Distance Digital Connection Technologies:**

Digital Telephony, Synchronous Communication, Digital Circuits and DSU, Telephone Standards DS Terminology and Data Rates, Lower Capacity Circuits, Intermediate Capacity Digital Circuits Highest Capacity Circuits, Optical Carrier Standards, the C Suffix, Synchronous Optical Network (SONET), the Local Subscriber Loop, ISDN, Asymmetric Digital Subscriber Line Technology Other DSL Technologies, Cable Modem Technology, Upstream Communication, Hybrid Fiber Coax.

**Unit IV: WAN Technologies** **[15 L]**

**WAN Technologies and Routing**

Large Networks and Wide Areas, Packet Switches, Forming A WAN, Store and Forward Physical Addressing In A WAN, Next-Hop Forwarding, Source Independence, Relationship of Hierarchical Addresses to Routing, Routing In A WAN, Use of Defaults Routes, Routing Table Computation, Shortest Path Computation in a Graph, Distributed Route Computation, Distance Vector Routing

**Network Ownership, Service Paradigm, and Performance**

Network Ownership, Virtual Private Networks, Service Paradigm, Connection Duration and Persistence, Examples of Service Paradigms, Addresses and Connection Identifiers, Network Performance Characteristics

**Protocols and Layering**

The Need for Protocols, Protocol Suites, A Plan for Protocol Design, the Seven Layers, Stacks: Layered Software, How Layered Software Works, Multiple, Nested Headers, the Scientific Basis for Layering,

**Text Books and References:**


1. Computer Networks and Internets, Douglas E. Comer Pearson Education Asia, 4th Edition.
2. Computer Network, Tuekeun, PHI
3. Networking Technology, Jaiswal, Galgotia.
4. Data Networking, Bertsekas, PHI
5. Data Communication and Networking, B.A Forouzan, McGraw-Hill.

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3034** | **Fuzzy Logic and Neural Networks [60 Lectures]** | **04** |

**Unit I : Introduction to Fuzzy logic: [15 L]**

Fuzzy sets, Properties, Operations on fuzzy sets, Fuzzy relations, Operations on fuzzy relations, The extension principle, Fuzzy measures, Membership functions, Fuzzification and defuzzification methods, Fuzzy controllers.

**Unit II: Introduction to Neural Networks: [15 L]**

Biological neurons, McCulloch and Pitts models of neuron, Types of activation function, Network architectures, Knowledge representation. Learning process: Error-correction learning, Supervised learning, Unsupervised learning, Learning Rules.

**Unit III: Perceptron : [15 L]**

**Single Layer Perceptron:** Perceptron convergence theorem, Method of steepest descent - least mean square algorithms. **Multilayer Perceptron**: Derivation of the back-propagation algorithm, Learning Factors.

**Simulated Annealing**: The Boltzmann machine, Boltzmann learning rule, Bidirectional Associative Memory.

**Unit IV: Radial Basis and Recurrent Neural Networks: [15 L]**

RBF network structure, theorem and the reparability of patterns, RBF learning strategies, K-means and LMS algorithms, comparison of RBF and MLP networks, Hopfield networks: energy function, spurious states, error performance .

**Text Books:**


1. Simon Haykin, "*Neural Network a - Comprehensive Foundation"*, Pearson Education
2. Zurada J.M., "*Introduction to Artificial Neural Systems*, Jaico publishers
3. Thimothy J. Ross, *"Fuzzy Logic with Engineering Applications"*, McGraw Hill
4. Ahmad Ibrahim, "*Introduction to Applied Fuzzy Electronics*", PHI


**References:**


1. Yegnanarayana B., "*Artificial Neural Networks"*, PHI
2. Driankov D., Hellendoorn H. & Reinfrank M., "*An Introduction to Fuzzy Control*", Norosa Publishing House
3. Berkan R.C., and Trubatch S.L., "*Fuzzy Systems Design Principles*", IEEE Press


| Course Code | Title | Credits |
|---|---|---|
| **PSCS3035** | **Natural Language Processing – I [60 Lectures]** | **04** |

**Unit I: Introduction to Natural language modelling: [15 L]**

Challenges and state-of-the-art research, Gellish, Lojban, UML and Navya Nyaaya, Language, metalanguage, artificial language and restricted language

**Unit II: Navya Nyaaya technical terms and graphical representations: [15 L]**

Relations and their semantics (hold, describe, correlate, reference, delimit, subject), comparisons with the modern modeling languages

**Unit III: Modeling natural language text: [15 L]**

Example text: Navya nyaaya bhasha pradeep – English translation

**Unit IV: Case study: [15 L]**

Modeling of an Indian language (e.g., Marathi, Hindi)

**References:**


1. Ujjwala Jha, **"**Navya nyaaya bhaasha pradeep (English translation)"

2. Dr. Shreenivasa Varakhedi, “Navya Nyaaya Paribhaasha”, 2004
3. http://www.gellish.net/downloads.html
4. John Cowan, “The complete Lojban Language”
5. Booch, Jacobson and Rumbaugh, OMG UML Specifications

**Electives II**
**Select any ONE from PSCS3041 TO PSCS3045**

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3041** | **Pattern Recognition [60 Lectures]** | **04** |

**Unit I: [15 L]**

**Introduction to Bayesian Decision Theory:** Machine perception, Pattern recognition systems, Design cycle, Learning and Adaptation. Bayesian decision theory: Continuous features, Minimum-error rate classification, classification, Classifiers, Discriminant functions and Decision surfaces, Normal density, Discriminant functions for normal density, Bayes Decision theory: discrete features

**Maximum-Likelihood and Bayesian Parameter Estimation:** Maximum likelihood estimation, Bayesian estimation, Bayesian parameter estimation: Gaussian case and General theory, Problems of dimensionality, Hidden Markov Model

**Unit II: [15 L]**

**Nonparametric Techniques:** Density estimation, Parzen windows, $k_n$-Nearest-Neighbor estimation, Nearest-Neighbor rule, Matrics and Nearest-Neighbor classification

**Linear Discriminants Functions:** Linear discriminant functions and decision surfaces, Generalised linear discriminant functions, 2-Category linearly separable case, Minimising the Perceptron criterion function, Relaxation procedure, Non-separable behavior, Minimum squared error procedure, Ho-Kashyap procedures, Multicategory generalizations

**Unit III: [15 L]**

**Nonmetric Methods:** Decision tree, CART, ID3, C4.5, Gramatical methods, Gramatical interfaces

**Algorithm Independent Machine Learning:** Lack of inherent superiority of any classifier, Bias and Variance, Resampling for estimating statistic, Resampling for classifier design, Estimating and comparing classifiers, Combining classifiers

**Unit IV: [15 L ]**

**Unsupervised Learning and Clustering:** Mixture densities and Identifiability, Maximum-Likelihood estimations, Application to normal mixtures, Unsupervised Bayesian learning, Data description and clustering criterion function for clustering, Hierarchical clustering

**Applications of Pattern Recognition**

**Text Books:**

1. Duda, Hart, and Stock, “*Pattern Classification*”, John Wiley and Sons.
2. Gose, Johnsonbaugh and Jost, “*Pattern Recognition and Image analysis*”, PHI

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3042** | **Virtual Reality and Virtual Environment [60 Lectures]** | **04** |

**Unit I:** **[15 L]**

Real time computer graphics, Flight simulation, virtual environment, Benefits of virtual reality, Evolution of Virtual Reality, Historical perspective, scientific land marks

**3D Computer graphics**

The virtual world space, positioning the virtual observer, the perspective projection, Human vision, Stereo perspective projection, 3D clipping, colour theory, simple 3D modelling, illumination models, shading algorithms, radiosity, hiddensurface removal, realism, stereographic images

**Unit II:** **[15 L]**

**Geometric modelling**

From 2D to 3D, 3D space curves, 3D boundary representation,

**Geometrical Transformations**

Frames of reference, Modelling transformations, instances, picking flying, Scaling the VE, Collision detection

**A generic VR Systems**

The virtual Environment, The computer environment, VR Technology, Modes of Interaction, VR systems

**Unit III:** **[15L]**

**Animating the Virtual Environment**

Dynamics of numbers, the animation of objects, shape and object in-betweening, free-form deformation, particle systems

**Physical Simulation**

Objects falling in a gravitational field, rotating wheels, Elastic collisions, Projectiles, simple pendulums, springs, flight dynamics of an aircraft

**Human factors**

The eye, The ear, the somatic senses, Equilibrium

**Unit IV:** **[15 L]**

**Virtual Reality Hardware**

Sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR Systems

**Virtual Reality Software**

Modelling Virtual worlds, Physical simulation, VR tool kits

**Virtual Reality Applications**

Engineering, Entertainment, science, Education, training, Future Virtual environment, Modes of Interaction

**Text Books:**

Virtual Reality Systems John Vince- Pearson Education Asia

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3043** | **Bio – Informatics [60 Lectures]** | **04** |

**Unit I: Introduction [15 L]**

The biological sequence structure deficit- Genome Projects-pattern recognition and prediction –the role of chaperones-sequence Analysis-Homology and analogy.

**Unit II: Information Networks [15 L ]**

Review of computer communication networks-the European molecular biology network- EMBnet-National Center for Biotechnology Information-NCBI- virtual tourism.

**Unit III: Protein Information resources [15 L]**

Biological Data Bases-Primary sequence Databases-Composite Protein sequence databases-Secondary databases- Composite Protein pattern databases-structure classification databases-web addresses

**Unit IV: Genome Information resources [15 L]**

DNA Sequence Analysis, Pair-wise alignment Techniques, Multiple sequence alignment, Secondary database searching, Building a sequence search Protocol, Analysis packages

**Text Book & References:**


1. "Introduction to Bio – Informatics", by T.K. Attwood and D.J. Perry –smith, Longman, Essen, 1999
2. "Bio Informatics Computing", by Bryan Bergeron, Second Edition, Pearson Education, 2003.


| Course Code | Title | Credits |
|---|---|---|
| **PSCS3044** | **Optimization Techniques [60 Lectures]** | **04** |

**Unit I: Introduction: [15 L]**

Need for optimization and historical development classification and formulation of optimization problem, Classical optimization methods. , Calculus based methods, Enumerative schemes, Random search algorithms, Evolutionary algorithms.

**Linear Programming model:**

Formulation, objective function, constraints, decision variables, canonical and standard forms, parameters and variables, classical problems such as crew scheduling, Knap sack, napkin/caterer, product mix etc. Graphical method for two variable problems,

**Introduction to Simplex Methods:**

Simple simplex algorithm and tabular representation, types of solution such as feasible / non feasible, degenerate / non degenerate, optimal / sub optimal, unique / alternate / infinite optimal, bounded / unbounded value and solution and their interpretations from simplex table, cycling phenomena, mutual solution of problems involving upto three iterations.

**Unit II: Advanced Simplex Methods, Dual Simplex Algorithm and Duality: [15 L]**

Artificial Variables, Big – M and Two Phase Simplex Methods, Degeneracy, unbounded solution, Infeasible Solution. Dual Simplex Method.

Duality concept, dual problem formulation, dual simplex method, primal sub optimal - dual not feasible, and other primal - dual relations, interpretation of dual variables.

Duality Properties, sensitivity analysis for variation of parameter at a time.

**Unit III:** **[15 L]**

Transportation, Transshipment and Assignment models.

As special cases of LP model, Problem formulation and optimality conditions in Vogel's penalty and Hungarian methods of solution. Traveling salesman problem as a special case of assignment problem, sensitivity analysis manual solution of problems involving upto three iterations.

**Unit IV:** **[15 L]**

**Integer LP Models**

Gomary's Cutting plane algorithms, branch and bound technique for integer programming

**Simulation Models**

Monte Carlo or experimenting method based on Probabilistic behavior data and random numbers, application in Probabilistic real life problems

**Text Books:**

1. Operation Research - An Introduction by H.A. Taha.
2. Operations Research by P.K . Gupta, Hira S. Chand
3. Optimization Methods by Mital K.V
4. Operations Research by S.D. Sharma

**References:**

5. Statistical Distribution in Engineering by Karl Bury.
6. Artificial Intelligence Through Simulated Evolution by Foged, Owence and Walsh.
7. Conference proceedings – Annual conference on Evolution programming

| Course Code | Title | Credits |
|---|---|---|
| **PSCS3045** | **Principles of Robotics programming – I [60 Lectures]** | **04** |

**Unit I: Introduction to Microcontrollers:** **[15 L]**

Hardware-software code-sign, embedded memories, example embedded systems, sensors, interfacing techniques

**Unit II: Case Studies of Embedded Systems:** **[15 L]**

Digital Camera, Network Router, RTLinux

**Unit III: Introduction to Model based Design:** **[15 L]**

Finite State Machines, State-charts, Programming languages for embedded systems e.g., Handel-C and Esterel **.**

**Unit IV: Introduction to Real time systems:** **[15 L]**

Real time concepts, comparison of RTOS with traditional OS, required RTOS services and capabilities **.**

**References:**

**1.** Jack Ganssle, “The art of designing embedded systems”, Newnes, 1999

2. David Simon, “An embedded software primer”, Addison Wesley, 2000

3. C M Krishna and Kang G Shin, “RTS: Real-Time Systems”, MWH, 1997

4. J.A. Stankovic and K.Ramamritham, “Advances in Hard RealTime Systems”, IEEE Computer Society Press, Washington DC, 1993 (Selected papers and references)

**PRACTICALS**

Through the Third Semester there will be 4 hours Practical per week will be held based on Theory **PSCSP301, PSCSP302, PSCSP3031 TO PSCSP3035 and PSCS3041 TO PSCSP3045**

| **PSCSP301** | **Artificial Intelligence** | |
|---|---|---|
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | **02** |
| 8 | Unit 4 | |
| | | |
| **PSCSP302** | **Distributed Computing** | |
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | **02** |
| 8 | Unit 4 | |
| | | |
| | **Elective I**<br>**PSCSP3031 TO PSCSP3035** | |
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | |
| 8 | Unit 4 | **02** |
| | | |
| | **Elective II**<br>**PSCSP3041 TO PSCSP3045** | |
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | |
| 8 | Unit 4 | **02** |

**Semester IV**:

M.Sc. Computer Science Program of Semester-IV consists of four theory courses and four practical courses and one project. The details are as follows:

**Theory Courses:**

| **Theory Course** | Subjects | Lectures in Hours | Credits |
|---|---|---|---|
| **PSCS401** | Image Processing | **60** | **04** |
| **PSCS402** | Embedded Systems | **60** | **04** |
| | **Elective I (Select ONE from)** | **60** | **04** |
| **PSCS4031** | Advanced Computer Networks | | |
| **PSCS4032** | Information Security | | |
| **PSCS4033** | Satellite Communication | | |
| **PSCS4034** | Multimedia systems and convergence to technologies | | |
| **PSCS4035** | Natural Language Processing-II | | |
| | **Elective II (Select ONE from)** | **60** | **04** |
| **PSCS4041** | Computer Vision | | |
| **PSCS4042** | Java Technology | | |
| **PSCS4043** | Intelligent Systems | | |
| **PSCS4044** | Customer Relations Management | | |
| **PSCS4045** | Principles of Robotics Programming-II | | |
| | | **Total** | **16** |

**Practical courses:**

| **Practical Course** | Subjects | Practical Hours. | Credits |
|---|---|---|---|
| **PSCSP401** | Image Processing | **04** | **02** |
| **PSCSP402** | Embedded Systems | **04** | **02** |
| | **Elective I (Select ONE from)** | **04** | **02** |
| **PSCSP4031** | Advanced Computer Networks | | |
| **PSCSP4032** | Information Security | | |
| **PSCSP4033** | Satellite Communication | | |
| **PSCSP4034** | Multimedia systems and convergence to technologies | | |
| **PSCSP4035** | Natural Language Processing-II | | |
| | **Elective II (Select ONE from)** | **04** | **02** |
| **PSCSP4041** | Computer Vision | | |
| **PSCSP4042** | Java Technology | | |
| **PSCSP4043** | Intelligent Systems | | |
| **PSCSP4044** | Customer Relations Management | | |
| **PSCSP4045** | Principles of Robotics Programming-II | | |
| | **Total** | **16** | **08** |

# M.Sc. Computer Science
## Semester IV

| Course Code | Title | Credits |
|---|---|---|
| **PSCS401** | **Image Processing [60 Lectures]** | **04** |

**Unit I: Introduction to Image Processing Systems and Image Transforms [15 L]**

**Digital Image Processing Systems:** Introduction, Structure of human eye, Image formation in the human eye, Brightness adaptation and discrimination, Image sensing and acquisition, Storage, Processing, Communication, Display. Image sampling and quantization, Basic relationships between pixels

**Image Transforms (Implementation):** Introduction to Fourier transform, DFT and 2-D DFT, Properties of 2-D DFT, FFT, IFFT, Walsh transform, Hadamard transform, Discrete cosine transform, Slant transform, Optimum transform: Karhunen - Loeve (Hotelling) transform.

**UnitII: Image Enhancement Methods [15 L]**

**Image Enhancement in the Spatial Domain:** Gray level transformations, Histogram processing, Arithmetic and logic operations, Spatial filtering: Introduction, Smoothing and sharpening filters

**Image Enhancement in the Frequency Domain:** Frequency domain filters: Smoothing and Sharpening filters, Homomorphic filtering

**Unit III: Types Image Processing [15 L]**

**Wavelets and Multiresolution Processing:** Image pyramids, Subband coding, Haar transform, Series expansion, Scaling functions, Wavelet functions, Discrete wavelet transforms in one dimensions, Fast wavelet transform, Wavelet transforms in two dimensions.

**Morphological Image Processing:** Introduction, Dilation, Erosion, Opening, Closing, Hit-or-Miss transformation, Morphological algorithm operations on binary images, Morphological algorithm operations on gray-scale images

**UnitIV: Image Representation & Description, Compression & Segmentation [15 L]**

**Image Data Compression:** Fundamentals, Redundancies: Coding, Interpixel, Psycho-visual, Fidelity criteria, Image compression models, Error free compression, Lossy compression, Image compression standards: Binary image and Continuous tone still image compression standards, Video compression standards.

**Image Segmentation:** Detection of discontinuities, Edge linking and Boundary detection, Thresholding, Region based segmentation

**Image Representation and Description:** Representation schemes, Boundary descriptors, Regional descriptors

**References:**


1. R.C.Gonsales R.E.Woods**, "**Digital Image Processing", Second Edition, Pearson Education
2. Anil K.Jain, "Fundamentals of Image Processing", PHI.
3. William Pratt, "Digital Image Processing", John Wiley
4. Milan Sonka,Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision" Thomson Learning.
5. N Ahmed & K.R. Rao, "Orthogonal Transforms for Digital Signal Processing" Springer .
6. B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI.

| Course Code | Title | Credits |
|---|---|---|
| **PSCS402** | **Embedded Systems [60 Lectures]** | **04** |

**Unit I: [15l]**

**An overview of embedded systems:** Introduction to embedded systems, Categories and requirements of embedded systems, Challenges and issues related to embedded software development, Hardware/Software co-design, Introduction to IC technology, Introduction to design technology

**Embedded Software development:** Concepts of concurrency, processes, threads, mutual exclusion and inter-process communication, Models and languages for embedded software, Synchronous approach to embedded system design, Scheduling paradigms, Scheduling algorithms, Introduction to RTOS, Basic design using RTOS.

**Unit II: [15 L]**

**Embedded C Language:** Real time methods, Mixing C and Assembly, Standard I/O functions, Preprocessor directives, Study of C compilers and IDE, Programming the target device

**Unit III: [15 L]**

**Hardware for embedded systems:** Various interface standards, Various methods of interfacing, Parallel I/O interface, Blind counting synchronization and Gadfly Busy waiting, Parallel port interfacing with switches, keypads and display units, Memory and high speed interfacing, Interfacing of data acquisition systems, Interfacing of controllers, Serial communication interface, Implementation of above concepts using C language

**Unit IV: [15 L]**

**Study of ATMEL RISC Processor:** Architecture, Memory, Reset and interrupt , functions, Parallel I/O ports, Timers/Counters, Serial communication, Analog interfaces, Implementation of above concepts using C language, Implementation of above concepts using C language

**Case studies and Applications of embedded systems:** Applications to: Communication, Networking, Database, Process Control, Case Studies of: Digital Camera, Network Router, RTLinux

**Text Books:**


1. David E. Simon, "*An Embedded Software Primer* ", Pearson Education
2. Frank Vahid, Tony Givargis, "*Embedded System Design: A Unified Hardware/Software Introduction*", John Wiley
3. Barnett, Cox, O'Cull, "*Embedded C Programming and the Atmel AVR* ", Thomson Learning


**Reference Books:**


1. Raj Kamal, "*Embedded Systems*", TMH
2. Muhammad Ali Mazidi and Janice Gillispie Mazidi, "*The 8051Microcontroller and Embedded Systems"*, Pearson Education
3. Craig Hollabaugh, "*Embedded Linux*", Pearson Education
4. Myke Predko, "*Programming and Customizing the 8051 Microcontroller*", TMH

**Electives I**
**Select any ONE form PSCS4031 TO PSCS4035**

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4031** | **Advanced Computer Network [60 Lectures]** | **04** |

**Unit I: [15 L ]**

**Data Communications:** Business Drivers and Networking Directions : Data communication Past and future.

**Understanding the standards and their maker:** Creating standards: players and Process, Current forums, Standard protocols, Layered reference models: The OSIRM, Standard computer architectures.

**Introduction to Transmission Technologies:** Hardware selection in the design process.

**Optical Networking:** SONET/SDH standards, Dense wavelength division multiplexing (DWDM), Performance and Design considerations.

**Unit II: [15 L ]**

**Physical Layer Protocols and Access Technologies:** Physical Layer Protocols and Interfaces, Accessing the Network, Copper access technologies, Cable Access Technologies, Fiber Access Technologies, Air Access Technologies.

**Common Protocols and Interfaces in the LAN environment:** Data link layers protocols, LLC and MAC sub layer protocol, Ethernet, Token Ring, Token Bus and FDDI, Bridge protocols, Switching in the LAN environment.

**Frame Relay:** FR specification and design, VoFR: Performance and Design considerations, Advantages and disadvantages of FR.

**Common WAN Protocol:** ATM: Many faces of ATM, ATM protocol operation (ATM cell and Transmission), ATM networking basics, Theory of operations, B-ISDN protocol reference model, PHY layer, ATM layer (Protocol model), ATM layer and cell (Definition), Traffic descriptors and parameters, Traffic and Congestion control defined, AAL Protocol model, Traffic contract and QoS, User plane overview, Control plane AAL, Management plane, Sub-DS3 ATM, ATM public services.

**Unit III: [15 L ]**

**Common Protocols and Interfaces in the Upper Layers(TCP/IP):** Background (Routing protocols), TCP/IP suite, Network layer (Internetwork layer), Transport layer, Application layer, Addressing and routing design.

**Mature Packet Switched Protocol:** ITU Recommendation X.25, User connectivity, Theory of Operation, Network layer functions, X.75 Internetworking protocol, switched multimegabit data service (SMDS), SMDS and IEEE 802.6, Subscriber Interface and Access protocol, Addressing and Traffic control.

**Requirements Definition:** User requirements, Traffic sizing, Traffic characteristics, Protocols, Time and Delay considerations, Connectivity, Availability, Reliability and Maintainability, Service aspects, Budget constraints,.

**Unit IV:** **[15 L ]**

**Traffic Engineering and Capacity planning:** Background (Throughput calculations) , Traffic engineering basics (Traffic characteristics), Traditional Traffic engineering, Queued data and packet switched traffic modeling, Designing for peaks, Delay or Latency, Availability and reliability, Network performance modeling, Creating the traffic matrix, Capacity planning and Network vision, Design tool, Categories of tools, Classes of design tool, Components of design projects, Types of design projects.

**Technology Comparisons:** Circuits-message-packet and cell switching methods, Packet switching service aspects, Generic packet switching network characteristics, Private verses public networking, Public network service selection, Business aspects of Packet-Frame and cell switching services, High speed LAN protocols comparisons, Application performance needs.

**Access Network Design:** Network design layers, Access layer design, Access network capacity, network topology and hardware, completing the access network design.

**Backbone Network Design:** Backbone requirements, Network capacities, Topologies, Topologies strategies, Tuning the network.

**Text Books:**

1. Darren L Spohn, "Data Network Design", TMH
2. D. Bertsekas, R. Gallager, "Data Networks", PHI

**References:**

1. W.R. Stevens, "Unix Network Programming", Vol.1, Pearson Education
2. J.Walrand, P. Varaiya, "High Performance Communication Networks", Morgan Kaufmann
3. Y. Zheng, S. Akhtar, "Networks for Computer Scientists and Engineers", Oxford
4. A.S. Tanenbaum, "Computer Networks"
5. Peterson & Davie, "Computer Networks", Harcourt Asia.
6. James D. McCabe , "Practical Computer Analysis and Design", Harcourt Asia.

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4032** | **Information Security** **[60 Lectures]** | **04** |

**Unit I:** **[15l]**

**Security in Network: Model for Security:** Threats in Networks, Stealing Passwords, Social Engineering, Bugs and Backdoors, Authentication Failures, Protocol Failure, Information Leakage.

**Elementary Cryptography:** Terminology and Background, Cryptography and network security. Concepts of Encryption and Decryption. Cryptanalysis, Substation Cipher. Transpositions Good and Secure Encryption Algorithm, Trust worthy Encryption systems Data encryption standards (DES) and Advanced Encryption Standards (AES) Comparison of DES and AES.

**Classical Encryption Technique:** Symmetric and Asymmetric Encryption Systems, Stream and Block Ciphers, Contemporary Symmetric Ciphers, Confidentiality using Symmetric Encryption.

**Public Key Encryption and HASH Functions:** Public Key Cryptography and RSA, Message Authentication and Hash Function, Hash Algorithms, Digital Signatures and Authentication Protocols.

**Unit II:** **[15 L]**

**Firewalls:**

**Basic Concepts (for understanding the firewalls rules):** TCP Segment format IP Datagram format.

**Introduction:** Kinds of Firewalls, Packet Filters. Packet Filtering. Dynamic Packet Filters. Application-Level Filtering, Circuit-Level Gateways, Firewall Configurations, Demilitarized Zone (DMZ), Networks, Distributed Firewalls, Limitation of Firewalls.

**Filtering Services:**

Reasonable Services to Filter (Filter Rules to be applied): DNS, Web, FTP, NTP.

**DNS (Domain Name Server):** DNS overview, Protocol overview, Hierarchal Structure, Root Servers, Practical Experience.

**DNS Security:** Unpatched Servers, Misconfigured Servers.

**DNS Cache Poisoning:** Denial of Service Attack. Distributed Denial of Service Attack. Luring Users into a Crafted Site

**Unit III:** **[15 L]**

**Web Security:** Overview of Web Server Security. *Goal of Server Attack.* Web site defacement. Data corruption. Data Theft. Types of Attacks.

**Web Server Protection:** FTP (File Transfer Protocol) SMTP (Simple Mail Transfer Protocol). NTP (Network Time Protocol),

**Intrusion detection systems:** Types of IDSs. Goal for Intrusion Detection systems, IDS Strength and Limitation.

**Electronic Mail Security:** Security for E-mail. Designs, Example of Secure Email Systems, Pretty Good Privacy (PGP): How PGP works? *S/MIME (Secure Multipurpose Mail Extension):* MIME overview. S/MIME functionality.

**Unit IV:** **[15 L]**

**Wireless Application Protocol Security (WAP):**

**Privacy Enhanced Mail (PEM):** How PEM works?

**Secure Socket Layer (SSL):** The Position of SSL in TCP/IP Protocol Suite. How SSL Works? The Handshake Protocol. The Record Protocol. The Alert Protocol.

**The WAP Stack:** The Security Layer-Wireless Transport Layer Security (WTLS).

**IP Security:** Introduction and Overview: IPSec Protocols. The Internet Key Exchange (IKE) Protocol. Security Association (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), IPSec Key Management.

**Text Books:**


1. Cryptography and Network Security: Principles and practices., William Stallings-Third Edition
2. .Cryptography and Network Security., Atul Kahate
3. The complete Reference Network Security by Bragg, Rhodes-Ousley.
4. C. P. Pfleeger, and S. L. Pfleeger, .Security in Computing., Pearson Education.


**Reference:**


1. Matt Bishop**, .***Computer Security: Art and Science.*, Pearson Education
2. Kaufman, Perlman, Speciner, *.Network Security*.
3. Eric Maiwald, *.Network Security : A Beginner.s Guide*., TMH
4. Bruce Schneier, *.Applied Cryptography.*, John Wiley.
5. Macro Pistoia, *.Java Network Security* ., Pearson Education

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4033** | **Satellite Communication [60 Lectures]** | **04** |

**Unit I :Introduction to Satellite Communication [15 L]**

**Introduction:**

General Background, Frequency Allocations for Satellite Services, Basic Satellite System, System Design Considerations, Applications.

**Satellite Orbits:**

Introduction, Laws Governing Satellite Motion, Orbital Parameters, Orbital Perturbations, Inclined Orbits, Sun Synchronous Orbits.

**Unit II: Satellites and their Design Considerations [15 L]**

**Geostationary Satellites Systems:**

Geostationary Orbit, Antenna Look Angles, Polar Mount Antennas, Limits of Visibility, Earth Eclipse of Satellite, Near-Geostationary Satellites, Sun Transit Outage, Launching of Geostationary Satellites.

**Non Geostationary Orbit Satellite Systems:**

Introduction, Reasons, Design Considerations, Case Study, Example of Systems.

**Communication Satellites:**

Introduction, Design Considerations, Lifetime and Reliability, Spacecraft Sub-Systems, Spacecraft mass and Power Estimations, Space Segment Cost Estimates.

**Unit III: Polarization and Satellite Antennas [15 L]**

**Wave Propagation:**

Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Impairments,

**Polarization:**

Plane TEM Wave, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization Discrimination, Ionospheric Depolarization, Rain Depolarization, Ice Depolarization.

**Antennas:**

Antenna basics, Reciprocity Theorem for Antennas, Aperture Antennas, Horn Antennas, Parabolic Reflectors, Offset Feed, Double Reflector Antennas, Shaped Reflector Systems.

**Unit IV: Communication Link and Other Technical Considerations [15 L]**

**Link Design:**

Introduction, Equivalent Isotropic Radiate Power, Transmission Losses, Link Power Budget Equation, System Noise, Carrier to Noise Ratio for Uplink and Downlink, Combined Uplink and Downlink Carrier to Noise Ratio, Intermodulation Noise.

**Multiple Access Techniques:**

Introduction, FDMA, TDMA, FDMA/TDMA, Operation in a Multiple Beam Environment, CDMA, Multiple Access Examples.

**Earth Stations:**

Introduction, Design Considerations, General Configuration and Characteristics.

**Text Books & References**


1. Satellite Communications – Dennis Roddy – 3rd edition, Mc-Graw Hill publication
2. Satellite Communications systems – M. Richharia – 2nd edition, Mc Millan publication.

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4034** | **Multimedia Systems and Convergence of Technologies [60 Lectures]** | **04** |

**Unit I: [15l]**

**Introduction:** Defining the scope of multimedia, Hypertext and Collaborative research, Multimedia and personalised computing, Multimedia on the map, Emerging applications, The challenges

**The convergence of computers, Communications, and entertainment products**

The technology trends, Multimedia appliances, Hybrid Devices, Designers perspective, industry perspective of the future, Key challenges ahead, Technical, regulatory, Social

**Architectures and issues for Distributed Multimedia systems**

Distributed Multimedia systems, Synchronization, and QOS Architecture, The role of Standards, A frame work for Multimedia systems.

**Unit II: [15 L]**

**Digital Audio Representation and processing**

Uses of Audio in Computer Applications, Psychoacoustics, Digital representation of sound, transmission of digital sound, Digital Audio signal processing, Digital music making, Speech recognition and generation, digital audio and the computers

**Video Technology:**

Raster Scanning Principles, Sensors for TV Cameras, Colour Fundamentals, Colour Video, Video performance Measurements, Analog video Artifacts, video equipments, World wide television standards

**Digital Video and Image Compression**

Video compression techniques, standardization of Algorithm, The JPEG Image Compression Standard, ITU-T Recommendations, The EPEG Motion Video Compression Standard, DVI Technology

**Unit III: [15 L]**

**Operating System Support for Continuous Media Applications**

Limitation of Work station Operating system, New OS support, Experiments Using Real Time Mach

**Middleware System Services Architecture**

Goals of Multimedia System services, Multimedia system services Architecture, Media stream protocol

**Multimedia Devices, Presentation Services, and the User Interface**

Client control of continuous multimedia, Device control, Temporal coordination and composition, toolkits, hyper-applications

**Multimedia File systems and Information Models**

The case for multimedia information systems, The file system support for continuous Media, Data models for multimedia and Hypermedia information, Content- based Retrieval of Unstructured Data

**Multimedia presentation and Authoring**

Design paradigms and User interface, barriers to wide spread use, research trends

**Unit IV:** **[15 L]**

**Multimedia Services over the Public Networks**

Requirements, Architecture, and protocols, Net work services, applications

**Multimedia Interchange**

Quick time Movie File Format, QMFI, MHEG (Multimedia and Hypermedia Information Encoding Expert Group), Format Function and representation, Track model and Object model, Real Time Interchange

**Multimedia conferencing**

Teleconferencing Systems, Requirements of Multimedia Communications, Shared Application Architecture and embedded Distributed objects, Multimedia Conferencing Architecture

**Multimedia Groupware**

Computer and Video fusion approach to open shared wok place, High Definition Television and desktop computing, HDTV standards, Knowledge based Multimedia systems, Anatomy of an Intelligent Multimedia system

**Text Book:**

1. Multimedia Systems by John F. Koegel Buford- Pearson Education

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4035** | **Natural Language Processing – II [60 Lectures]** | **04** |

**Unit I: Structure of Indian languages – NLP view:** **[15 L]**

Morphology, word analysis and generation, higher order linguistic structures

**Unit II: Modules for NLP:** **[15 L]**

Taggers and Chunkers – Introduction to different models and software systems

**Unit III: Natural language text parser:** **[15 L]**

Constituent structure, dependency structure and Paninian approach of sentence parsing

**Unit IV: Semantic analysis:** **[15 L]**

Lexical resources, machine learning and semantic analysis, case study – an Indian language text processing (e.g., Marathi, Hindi)

**References:**

1. G.U. Rao, “Natural Language Modeling”, HCU, 2006
2. V. Chaitanya and R. Sangal, “Natural Language Processing: Paninian perspective”, PHP, 1997

**Electives II**
**Select any ONE from PSCS4041 TO PSCS4045**

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4041** | **Computer Vision [60 Lectures]** | **04** |

**Unit I: [15 L]**

**Recognition Methodology:** Conditioning, Labeling, Grouping, Extracting, Matching. Edge detection, Gradient based operators, Morphological operators, Spatial operators for edge detection. Thinning, Region growing, region shrinking, Labeling of connected components.

**Binary Machine Vision:** Thresholding, Segmentation, Connected component labeling, Hierarchal segmentation, Spatial clustering, Split & merge, Rule-based Segmentation, Motion-based segmentation.

**Unit II: [15 L]**

**Area Extraction:** Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting).

**Region Analysis:** Region properties, External points, Spatial moments, Mixed spatial gray-level moments, Boundary analysis: Signature properties, Shape numbers.

**Unit III: [15 L]**

**Facet Model Recognition:** Labeling lines, Understanding line drawings, Classification of shapes by labeling of edges, Recognition of shapes, Consisting labeling problem, Back-tracking, Perspective Projective geometry, Inverse perspective Projection, Photogrammetry – from 2D to 3D, Image matching : Intensity matching of ID signals, Matching of 2D image, Hierarchical image matching.

**Object Models And Matching:** 2D representation, Global vs. Local features.

**Unit IV: [15 L]**

**General Frame Works For Matching:** Distance relational approach, Ordered- structural matching, View class matching, Models database organization.

**General Frame Works:** Distance –relational approach, Ordered –Structural matching, View class matching, Models database organization.

**Knowledge Based Vision:** Knowledge representation, Control-strategies, Information integration.

**Text Books:**


1. David A. Forsyth, Jean Ponce, *"Computer Vision: A Modern Approach"*
2. R. Jain, R. Kasturi, and B. G. Schunk, *"Machine Vision"*, McGraw-Hill.


**References:**


1. Milan Sonka,Vaclav Hlavac, Roger Boyle, "*Image Processing, Analysis, and Machine Vision*" Thomson Learning
2. Robert Haralick and Linda Shapiro, *"Computer and Robot Vision"*, Vol I, II, Addison-Wesley, 1993.

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4042** | **Java Technology [60 Lectures]** | **04** |

**Unit I: [15 L]**

**Java Programming**

Object oriented programming revisited, JDK, Java Virtual machine-Platform independent-portability-scalability Operators and expressions-decision making ,branching, looping, Classes, Objects and methods, Arrays Strings and Vectors, Interfaces, Packages, Multi-Threading, managing errors and exceptions, Applet programming, Managing files and streams. Java Technology, the Java Run-Time Environment, The Java Library. A Graphics Toolkit, Using Java Graphics on a Particular Computer, Java Interpreters and Browsers. Compiling a Java Program, Invoking an Applet, Example of Interaction with a Browser

**Unit II: [15 L]**

**Use of Java Active Web Documents** An Early Form of Continuous Update, Active Documents and Server Overhead, Active Document Representation and Translation,

**RPC and Middleware**

Programming Clients and Servers, Remote Procedure Call Paradigm, RPC Paradigm, Communication Stubs, External Data Representation, Middleware and Object-Oriented Middleware.

**UnitIII: [15 L]**

**Network Management (SNMP)**

Managing an Internet, The Danger of Hidden Features, Network Management Software, Clients, Servers, Managers and Agents, Simple Network Management Protocol, Fetch-Store Paradigm, The MIP and Object Names, The Variety of MIB Variables, MIB variables that correspond to arrays

**Unit IV: [15 L]**

**Java technologies**

Graphics, JFC-JAVA foundation classes, swing, images, java 2d graphics, internationalization, Communication and Networking, TCP Sockets, UDP Sockets, ***java.net,*** java security, Object serialization, Remote method serialization, JDBC: Java Data Base Connectivity, Java beans, Java interface to CORBA, JAVA- COM Integration, Java Media Framework, commerce and java wallet, Data structures and java utilities, JavaScript, Servelets.

**Text Books & References:**


1. Using JAVA 2, Joseph L weber, PHI
2. JAVA 2 complete, Sybex, BPB
3. Java2 The complete Reference, Patrick Naughton, T M H
4. Computing concepts With JAVA2, Cay Horstmann, WILEY
5. JSP Java Server Pages, Barry Burd, IDG Books India(p) Ltd
6. Java2 Programming Bible, Aaron Walsh, IDG Books India(p) Ltd
7. Java2, swing, servlets, JDBC & JAVA Beans Programming Black Book Steven Holzner dreamtech press

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4043** | **Intelligent Systems [60 Lectures]** | **04** |

**Unit I:** **[15 L]**

**Artificial Intelligence**: An overview, Intelligent Systems: Evolution of the concept.
**Problem Solving:** Solving problems by searching, Informed search methods, Game playing
**Knowledge and Reasoning:** A knowledge based agent, The wumpus world environment, Representation, Reasoning, Logic, Proportional logic, First order logic: Syntax and Semantics, Extensions and Notational variation, Using first order logic.
**Intelligent Agents**: How agent should act, Structure of intelligent agents, Environments.

**Unit II:** **[15 L]**

**Building a Knowledge Base:** Properties of good and bad knowledge base, Knowledge engineering, General ontology
**Interfacing First Order Logic:** Interface rules involving quantifiers, An example proof, Forward and backward chaining, Completeness
**Acting Logically:** Planning, Practical planning: Practical planners, Hierarchical decomposition, Conditional planning

**Unit III:** **[15 L]**

**Uncertain Knowledge and Reasoning:** Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief networks, Inference in belief networks
**Learning:** Learning from observations: General model of learning agents, Inductive learning, learning decision trees, Learning in neural and belief networks: Introduction to neural networks, Perceptrons, Multilayer feed-forward network, Application of ANN, Reinforcement learning: Passive learning in a known environment, Generalization in reinforcement learning, Genetic algorithms

**Unit IV:** **[15 L]**

**Agents that Communicate:** Communication as action, Types of communicating agents, A formal grammar for a subset of English
**Expert system:** Introduction to expert system, Representing and using domain knowledge, Expert system shells, Explanation, Knowledge acquisition
**Applications:** Natural language processing, Perception, Robotics

**Text Books:**


1. Struart Russell and Peter Norvig, "*Artificial Intelligence: A Modern Approach*"
2. George F.Luger, *"Artificial Intelligence: Structures and Strategies for Complex Problem Solving"*, Pearson Education


**References:**


1. Nils J. Nillson, *"Artificial Intelligence: A New Synthesis"*, Harcourt Asia
2. Elaine Rich and Kevin Knight, "*Artificial Intelligence"*, TMH
3. Patrick Winston, "*Artificial Intelligence"*, Pearson Education
4. Ivan Brakto, "*Prolog Programming for Artificial Intelligence*", Pearson Education
5. Efraim Turban Jay E.Aronson, "*Decision Support Systems and Intelligent Systems*"
6. Ed. M. Sasikumar and Others, *"Artificial Intelligence : Theory and Practice"* Proceedings of the International Conference KBCS-2002, Vikas Publishing House

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4044** | **Customer Relationship Management(CRM) [60 Lectures]** | **04** |

**Unit I: [15L]**

**Introduction to CRM :** what is a customer? How do we define CRM? CRM technology, CRM technology components, customer life style, customer interaction.

**Introduction to eCRM :** difference between CRM & eCRM, features of eCRM.

**UnitII: [15 L]**

**Sales Force Automation (SFA):** definition & need of SFA, barriers to successful SFA, SFA: functionality, technological aspect of SFA: data synchronization , flexibility & performance , reporting tools.

**Enterprise Marketing Automation (EMA):** components of EMA, marketing camping, camping, planning & management, business analytic tools, EMA components (promotions, events, loyalty & retention programs), response mgmt.

**Unit III: [15 L]**

**Call Centers Mean Customer Interaction:** the functionality, technological implementation, what is ACD (automatic call distribution),IVR(interactive voice response), CTI(computer telephony integration),web enabling the call center, automated intelligent call routing, logging & monitoring.

**UnitIV: [15 L]**

**Implementing CRM:** pre implementation, kick off meeting, requirements gathering, prototyping & detailed proposal generation, development of customization, Power User Beta Test & Data import, training, roll out & system hand off, ongoing support , system optimization, follow up.

**Introduction to ASP( application service provider):** who are ASP's?, their role & function, advantages & disadvantages of implementing ASP

**Text Books and References:**

1. CRM at the speed of light by Paul Greenberg, TMH.
2. Customer R elations Management by Kristin Anderson & Carol Kerr. TMH.

| Course Code | Title | Credits |
|---|---|---|
| **PSCS4045** | **Principles of Robotics programming – II [60 Lectures]** | **04** |

**Unit I: Scheduling concepts & theory: [15 L]**

Scheduling paradigms – static and dynamic scheduling, current best practice in scheduling (Rate monotonic Vs. Static schedules)

**Unit II: RTOS (basics and examples): [15 L]**

Real world issues – blocking, unpredictability, interrupts, caching, example RTOS -- RT Linux and VRTX

**Unit III: Interfacing and communication: [15 L]**

Example embedded system based applications – Robotics, process control, employing development methodology.

**Unit VI: Digital control systems: [15 L]**

Controlling an injection molding process, flight simulator, digital call center handler, codec (Any one or two)

**Text Books & References:**

**1.** Jack Ganssle, "The art of designing embedded systems", Newnes, 1999
2. David Simon, "An embedded software primer", Addison Wesley, 2000
3. C M Krishna and Kang G Shin, "RTS: Real-Time Systems", MWH, 1997
4. J.A. Stankovic and K.Ramamritham, "Advances in Hard RealTime Systems", IEEE Computer Society Press, Washington DC, 1993 (Selected papers and references)

**PRACTICALS:**

Through the Fourth Semester there will be 4 hours Practical per week will be held based on Theory **PSCSP401, PSCSP402, PSCSP4031 TO PSCSP4035 and PSCSP4041 TO PSCSP4045 and one project work PSCSPR405.**

| **PSCSP401** | **Image Processing** | |
|---|---|---|
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | **02** |
| 8 | Unit 4 | |
| | | |
| **PSCSP402** | **Embedded Systems** | |
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | **02** |
| 8 | Unit 4 | |
| | | |
| | **Electives I – PSCSP4031 TO PSCSP4035** | |
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |
| 6 | Unit 3 | |
| 7 | Unit 4 | **02** |
| 8 | Unit 4 | |
| | | |
| | **Electives II – PSCSP4041 TO PSCSP4045** | |
| 1 | Unit 1 | |
| 2 | Unit 1 | |
| 3 | Unit 2 | |
| 4 | Unit 2 | |
| 5 | Unit 3 | |

| | | |
|---|---|---|
| 6 | Unit 3 | **02** |
| 7 | Unit 4 | |
| 8 | Unit 4 | |
| | | |

**Project: <u>General Guidelines for Project to be done in Semester IV</u>**

The syllabus proposes the introduction of a project to be done by students in Semester IV. The objective of introducing the Project is to introduce a **Project Based Learning which helps the student**

**1. To explore the important core and applications areas of Computer Science.**

**2. To know about innovations, technological developments and new research initiatives in various areas of Computer Science.**

**3. To motivate students to write a research or technical paper on the project undertaken by them.**

This makes the course learner centered and helps them to understand the concepts covered in the syllabus and how to apply to real life situations. Working on a project is expected to increase the problem solving ability and analytical thinking, thus helping them to face the industrial and professional demands (at least partially) once he or she completes the course.

- The projects shall be undertaken by the students under the guidance of the teacher teaching

| **Project Work** | **Subject** | **Hours.** | **Credits** |
|---|---|---|---|
| PSCSPR405 | Project | 100 | 06 |

course or the experts approved by the teacher In charge.

- The whole class shall be divided into different batches, which can be distributed among the teachers teaching the courses.
- Each student can chose a topic with the approval of the teacher In charge.
- The topic selected should be related to the topics covered in the syllabus or any other allied area of Computer Science.
- The project work should be spread over a period of at least 16 weeks.
- The project should cover problem solving using the concepts mentioned in the syllabus, and approved by the teacher.
- Students may use the technology or programming languages covered in the syllabus. However, they may have the freedom to use other technologies or programming languages.
- Weightage shall be given to research projects, live projects and the projects with new concepts.
- At the end of the project, the students need to submit a typed project report of around 50 – 100 pages with the following details:
    - **I.** Title
    - **II.** Introduction
    - **III.** Objective
    - **IV.** Methodology used
    - **V.** Experimental set up
    - **VI.** Results
    - **VII.** Conclusion
    - **VIII.** Reference
    - **IX.** Appendix (includes the coding used and additional results (if any))

## Scheme of Examination for Theory Courses

There will be an internal and external examination for the Theory Courses. The Weightage of internal/ external and scheme of examination will be as per common guidelines provided by the University for all the PG courses in the faculty of Science.

## Scheme of Examination for Practical Courses

There will not be any internal examination for practical courses.

**External Examination for practical courses:**

The particulars of the external practical examination for each practical course are given below:

| Sr. No. | Particulars for External Practical Examination | | Marks |
|---|---|---|---|
| 1 | Semester End Practical Examination | | 50 Marks |
| | Laboratory Work | 40 Marks | |
| | Journal | 05 Marks | |
| | Viva | 05 Marks | |

1. Students should maintain a journal for each practical course with at least twelve practical experiments from the list of practical experiments.
2. External Examination on practical courses will be clubbed into two groups – Group A and Group B. The pattern of external practical examination for semester I and Semester II is given below:

**Semester III:**

| Group | Duration of Examination | Course | Credits | Maximum Marks | Marks for Experiment | Marks for Viva | Marks for Journal |
|---|---|---|---|---|---|---|---|
| Group A | 4 hours | PSCSP301 | 2 | 50 | 40 | 5 | 5 |
| | | PSCSP302 | 2 | 50 | 40 | 5 | 5 |
| Group B | 4 hours | ELECTIVE I PSCSP3031 TO PSCSP3035 | 2 | 50 | 40 | 5 | 5 |
| | | ELECTIVE II PSCSP3041 TO PSCSP3045 | 2 | 50 | 40 | 5 | 5 |

**Semester IV:**

| Group | Duration of Exam | Course | Credits | Maximum Marks | Marks for Experiment | Marks for Viva | Marks for Journal |
|---|---|---|---|---|---|---|---|
| Group A | 4 hours | PSCSP401 | 2 | 50 | 40 | 5 | 5 |
| | | PSCSP402 | 2 | 50 | 40 | 5 | 5 |
| Group B | 4 hours | ELECTIVE I PSCSP4031 TO PSCSP4035 | 2 | 50 | 40 | 5 | 5 |
| | | ELECTIVE II PSCSP4041 TO PSCSP4045 | 2 | 50 | 40 | 5 | 5 |

## Scheme of Examination for PROJECT ASSESSMENT to be held in Semester IV

The students have to make a presentation of about **20 TO 30** minutes based on the project before the examiners. The examiners will evaluate the project as per the following evaluation scheme:

| **PSCSPR405** | Project Work | **Marks** |
|---|---|---|
| | ▪ Selection of the topic<br>▪ Experimental Set up / Methodology used<br>▪ Understanding / Rigour/ Research component<br>▪ Results and conclusion<br>▪ Documentation<br>▪ Presentation of the Project | 10 marks<br>20 marks<br>20 marks<br>20 marks<br>10 marks<br>20 marks |
| | **Maximum Marks** | 100 marks |