AC 10/02/2012
Item No. 4.43

UNIVERSITY OF MUMBAI

Syllabus for the M.Sc. Part - I
Program: M.Sc.
Course : Computer Science

(Credit Based Semester and Grading System with effect from the academic year 2012–2013)

Preamble

This syllabus is the extension of the existing syllabus which is currently being taught to MSc Computer Science of University of Mumbai for the last few years, but modified to be placed within the credit based system to be implemented from the academic year 2012-2013. 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 subjects for each of the semesters. Each subject has theory as well as practical components. The theory component offers 4 credits and practical component offers 2 credits. Thus, each semester is of 24 credits. The four subjects in the first semester are Principles of Compiler Design- I, Digital Signal Processing- I, Mobile Computing, and Data warehousing and mining. The second semester offers Principles of Compiler Design-II, Digital Signal Processing- II, Computer Simulation and Modelling, and Advanced Database Systems. Each of the theory paper has five units and is expected to cover in 60 lecture periods. Each of the practical paper is of 60 hours duration.

It is believed that the proposed changes as part of the credit based system will bring a qualitative change in the way MSc Computer Science is taught, which will offer a more enriched learning experience.

Revised syllabus of M.Sc. Computer Science
(Based on Credit and grading system)

Semester I							
Paper code	Paper nomenclature	Lectures	Credit	Practical Paper	Hrs	Credit	Total Credit
PSCS101	Principles of Compiler Design-I	60	04	Paper I	60	02	06
PSCS102	Digital Signal Processing-I	60	04	Paper II	60	02	06
PSCS103	Mobile Computing	60	04	Paper III	60	02	06
PSCS104	Data Warehousing and Mining	60	04	Paper IV	60	02	06
						Total	**24**
Semester II							
PSCS201	Principles of Compiler Design-II	60	04	Paper V	60	02	06
PSCS202	Digital Signal Processing-II	60	04	Paper VI	60	02	06
PSCS203	Computer Simulation & Modeling	60	04	Paper VII	60	02	06
PSCS204	Advanced Database Systems	60	04	Paper VIII	60	02	06
						Total	**24**

Total credits for M.Sc. Part I =(Semester I - 24 and Semester II - 24) =48

Evaluation: The students will be evaluated internally and externally. The external evaluation will be done by the committee appointed by the University norms. Standard passing and scale will be as per the university norms.

M.Sc. Part - I Computer Science Syllabus
Restructured for Credit Based and Grading System

SEMESTER: I

Paper I: Principles of Compiler Design-I: PS**CS101**

Paper II: Digital Signal Processing-I: PS**CS102**

Paper II: Mobile Computing: PS**CS103**

Paper III: Data Warehousing and Mining: PS**CS104**

SEMESTER: II

Paper IV: Principles of Compiler Design-II: PS**CS201**

Paper V: Digital Signal Processing-II: PS**CS202**

Paper VI: Computer Simulation & Modelling: PS**CS203**

Paper VIII: Advanced Database Systems: PS**CS204**

SEMESTER I

Paper I: Principles of Compiler Design-I: PS**CS 101**

PSCS**101**	I	Introduction to Compilers	**4**
	II	Programming languages	
	III	Finite automata and lexical analysis	
	IV	The syntactic specification of Programming Languages and Basic Parsing Techniques	
	V	Automatic Construction of Efficient Parsers	

Paper II: Digital Signal Processing-I: PS**CS 102**

PSCS**102**	I	Theory of Discrete-Time Linear Systems	**4**
	II	The Theory and approximation of Finite Duration Impulse response digital filters	
	III	Theory and approximation of Infinite Impulse, Response digital filters	
	IV	Finite word length effects in digital filters	
	V	Spectrum Analysis and the Fast Fourier Transform	

Paper III : Mobile Computing: **CS 103**

PSCS**103**	I	Introduction, Wireless Transmission and Medium Access Control	**4**
	II	Telecommunication, Satellite and Broadcast Systems	
	III	Wireless LAN and ATM	
	IV	Mobile Network and Transport Layer	
	V	Support for Mobility	

Paper IV: Data Warehousing and Mining: **CS 104**

PSCS**104**	I	Introduction to Data warehousing	**4**
	II	Designing and maintaining Data warehouse	
	III	Introduction to Data Mining	
	IV	Data Mining Algorithms	
	V	Advanced topics	

Detail Syllabus

Semester I

Course Code	Title	Credits
PSCS 101	**Principles of Compiler Design-I [60 Lectures]**	**4**

Unit I: Introduction to Compilers:

Compilers and translators, Why do we need translators?, The structure of a compiler, Lexical analysis, Syntax analysis, Intermediate code generation, Optimization, Code generation, Book keeping, Error handling, Compiler writing tools **[08L]**

Unit II: Programming languages:

High-level programming languages, Definitions of programming languages, The lexical and syntactic structure of a language, Data elements, Data structures, Operators, Assignment, Statements, Program units, Data environments, Parameter transmission, Storage management **[05L]**

Unit III: Finite automata and lexical analysis:

The role of the lexical analyzer, A simple approach to the design of lexical analyzers, Regular expressions, Finite automata, From regular expressions to finite automata, Minimizing the number of states of a DFA,A language for specifying lexical analyzers, Implementation of a lexical analyzer **[16L]**

Unit IV: The syntactic specification of Programming Languages and Basic Parsing Techniques:

Context-free grammars, Derivations and parse trees, Capabilities of context-free grammars, Parsers, Shift-reduce parsing, Operator-precedence parsing, Top-down parsing, Predictive parsers **[15L]**

Unit V: Automatic Construction of Efficient Parsers:

LR parsers, The canonical collection of LR(0) items, Constructing SLR parsing tables, Constructing canonical LR parsing tables, Constructing LALR parsing tables, Using ambiguous grammars, An automatic parser generator, Implementation of LR parsing tables, Constructing LALR sets of items **[16L]**

References:

Principles of Compiler Design, Alfred V. Aho & Jeffrey D. Ullman

Course Code	Title	Credits
Course Code	Title	Credits
PSCS 102	**Digital Signal Processing –I [60 Lectures]**	**4**

Unit I: Theory of Discrete-Time Linear Systems

Sequences-Representation of arbitrary sequences-Linear time variant systems-causality, stability- difference equations-frequency response-first order systems-second order systems-Discrete Fourier series-relation between continuous and discrete Systems. The z Transform-the Relation between the z Transform and the Fourier transform of a sequence-Solution of differences equation using one sided transform-geometric evaluation of the Fourier Transform-Digital Filter Realizations-structures for all zero filters-the discrete Fourier transform – convolution of sequences-linear convolution of finite duration sequences-the discrete Hilbert transform. **[20L]**

Unit II: The Theory and approximation of Finite Duration Impulse response digital filters

Issues in Filter design-FIR filters Design techniques for Linear phase FIR filters-windowing-issues with windowing-frequency sampling-solution for optimization-linear programming-linear phase filters-Maximal ripple FIR Filters –Remez exchange algorithm- Multiple band optimal FIR Filters-Design of filters with simultaneous constrains on the time and frequency response.**[10L]**

Unit III: Theory and approximation of Infinite Impulse, Response digital filters

IIR filters-filter coefficient-Digital Filter Design –Mapping of differentials-Transformations-Direct design of digital filters-comparison between FIR filters and IIR filters**.[10L]**

Unit IV: Finite word length effects in digital filters

Analog to digital conversions-digital to analog conversions-types of Arithmetic in digital systems. Types of quantization in digital filters-Dynamic range Constraints-Realizations-ordering and pairing in cascade realizations-round of noise-fixed point analysis-Coefficient quantization – Limit cycle oscillations**.[10L]**

Unit V: Spectrum Analysis and the Fast Fourier Transform

Introduction to Radix-2 FFT's-data shuffling and bit reversal-FFT computer programming-Decimation –in-Frequency Algorithm –Computing an Inverse DFT by doing a Direct DFT-Radix2 Algorithm-Spectrum analysis at a single point in the z plane-spectrum analysis in FFT Analysis-Windows in spectrum Analysis-Bluestein's Algorithm-The chirp z transform algorithm- convolution and correlation using number theoretic transforms.**[10L]**

References:

1) Theory and application of Digital signal processing Lawrence R. Rabiner Bernard Gold-prentice hall of India.
2) Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis.
3) Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith
4) Discrete-Time Signal Processing by A. V. Oppenheim and R. W. Schafer.
5) Understanding Digital Signal Processing by Richard G. Lyons.

PSCS 103	Mobile Computing [60 Lectures]	4

Unit I: **Introduction, Wireless Transmission and Medium Access Control**: Applications, A short history of wireless communication. Wireless Transmission: Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems. Medium Access Control: Motivation for a specialized MAC: Hidden and Exposed terminals. Near and Far terminals; SDMA, FDMA, TDMA: Fixed TDM, Classical Aloha, Slotted Aloha, Carrier sense multiple access, Demand assigned multiple access, PRMA packet reservation multiple access, Reservation TDMA, Multiple access with collision avoidance, Polling, Inhibit sense multiple access; CDMA: Spread Aloha multiple access. **(14 L)**

Unit II: Telecommunication, Satellite and Broadcast Systems: GSM: Mobile services, System architecture, Radio interface, Protocols, Localization And Calling, Handover, security, New data services; DECT: System architecture, Protocol architecture; ETRA, UMTS and IMT-2000: UMTS Basic architecture, UTRA FDD mode, UTRA TDD mode, Satellite Systems: History, Applications, Basics: GEO, LEO, MEO; Routing, Localization, Handover, Examples Broadcast Systems: Overview, Cyclic repetition of data, Digital audio broadcasting: Multimedia object transfer protocol; Digital video broadcasting. **(12L)**

Unit III: Wireless LAN and ATM: Infrared vs. Radio transmission, Infrastructure and Ad hoc Networks, IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium access control layer, MAC management, Future development; HIPERLAN: Protocol architecture, Physical layer, Channel access control. Sublayer, Medium access control Sublayer, Information bases And Networking; Bluetooth: User scenarios, Physical layer, MAC layer, Networking. Security, Link management. Wireless ATM: Motivation for WATM, Wireless ATM working group, WATM services, Reference model: Example configurations, Generic reference model; Functions: Wireless mobile terminal side, Mobility supporting network side; Radio access layer: Requirements, BRAN; Handover: Handover reference model, Handover requirements, Types of handover, Handover scenarios, Backward handover, Forward handover; Location management: Requirements for location management, Procedures and Entities; Addressing, Mobile quality of service, Access point control protocol. **(13 L)**

Unit IV: Mobile Network and Transport Layers: Mobile IP: Goals, assumptions and requirements, Entities and Terminology, IP packet delivery, Agent advertisement and discovery, Registration, Tunneling and Encapsulation , Optimizations, Reverse tunneling, Ipv6; Dynamic host configuration protocol, Ad hoc networks: Routing, Destination sequence distance vector, Dynamic source routing, Hierarchical algorithms, Alternative metrics, Mobile Transport Layer: Traditional TCP: Congestion control, Slow start, Fast retransmit/fast recovery, Implications on mobility; Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission/time-out freezing, Selective retransmission, Transaction oriented TCP. **(11 L)**

Unit V: Support for Mobility: File systems: Consistency, Examples; World Wide Web: Hypertext transfer protocol, Hypertext markup language, Some approaches that might help wireless access, System architectures; Wireless application protocol: Architecture, Wireless datagram protocol, Wireless transport layer security, Wireless transaction protocol, Wireless session protocol, Wireless application environment, Wireless markup language, WML script, Wireless telephony application, Examples Stacks with Wap, Mobile databases, Mobile agents. **(10 L)**

References:

1. Jochen Schiller, .*Mobile communications.*, Addison wisely , Pearson Education
2. William Stallings, .*Wireless Communications and Networks*.
3. Rappaort, .*Wireless Communications* P*rincipals and Practices*.
4. YI Bing Lin , .*Wireless and Mobile Network Architectures*., John Wiley
5. P. Nicopolitidis , .*Wireless Networks*., John Wiley
6. K Pahlavan, P. Krishnamurthy, *Principles of Wireless Networks*.
7. M. Richharia , .*Mobile Satellite Communication: Principles and Trends*., Pearson Education

Course Code	Title	Credits
PSCS104	**Data Warehousing and Data Mining [60 Lectures]**	4

Unit I : Introduction to Data warehousing

1. Overview and Concepts: Need for data warehousing, Basic elements of data warehousing, Trends in data warehousing.
2. **Planning and Requirements**: Project planning and management, Collecting the requirements.
3. **Architecture And Infrastructure:** Architectural components, Infrastructure and metadata.

[10L]

Unit II: Designing and maintaining Data warehouse

1. **Data Design And Data Representation:** Principles of dimensional modeling, Dimensional modeling advanced topics, data extraction, transformation and loading, data quality.
2. **Information Access And Delivery:** Matching information to classes of users, OLAP in data warehouse, Data warehousing and the web.
3. **Implementation And Maintenance:** Physical design process, data warehouse deployment, growth and maintenance.

[10L]

Unit III Introduction to Data mining

1. **Introduction:** Basics of data mining, related concepts, Data mining techniques. Data types: Nominal; Ordinal; Interval; Ratio, Data Issues: Missing values; Noisy values; Inconsistent values; redundant values. Data pre-processing and discretization.
2. **Knowledge Discovery:** KDD Process.
3. **Algorithms for Classification**

[15L]

Unit IV Data Mining Algorithms

1. Clustering.
2. Association rules.

[15L]

Unit V: Advanced topics

1. **Web Mining:** Web Content Mining, Web Structure Mining, Web Usage Mining.
2. **Advanced Topics:** Spatial mining, Temporal mining.
3. **Visualisation :** Data generalization and summarization-based characterization, Analytical characterization: analysis of attribute relevance, Mining class comparisons:

[10L]

References:

(1) Paulraj Ponnian, "*Data Warehousing Fundamentals*", John Wiley.
(2) Ralph Kimball, "*The Data Warehouse Lifecycle toolkit*", John Wiley.
(3) Dunham, Margaret H, Data Mining: Introductory and Advanced Topics, Prentice Hall.
(4) Witten, Ian and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann.

Additional Reference Books:-

(1) W.H. Inmon, "*Building the Data Warehouses*", Wiley Dreamtech.
(2) R. Kimpall, "*The Data Warehouse Toolkit*", John Wiley.
(3) E.G. Mallach, "*Decision Support and Data Warehouse systems*", TMH.
(4) Han and Kamber, Data Mining: Concepts and Techniques, Second Edition, Morgan Kaufmann, 2006.

(5) Berry, Browne, Lecture Notes in Data Mining, World Scientific, 2006.
(6) Berry and Linoff, Data Mining Techniques, Second Edition, Wiley, 2004.
(7) Inmon, Building the Data Warehouse, Wiley, 1993.

PRACTICALS

At the end of First Semester there will be a practical examination based on Theory PSCS 101, PSCS 102, PSCS 103 and PSCs 104.

PSCS-P1	**Principles of Compiler Design using C/C++/Java** 1. Right linear grammar to left linear grammar 2. Conversion of NDFA to DFA 3. Implementation of Warshall Algorithm and Kleen Closure 4. Simple Precedence Matrix 5. Parsing using Simple Precedence Matrix 6. Linearising Simple Precedence Matrix 7. Parsing using Simple Precedence Function	**2**
PSCS-P2	**Digital Signal Processing using Matlab** 1. Basic Signals. 2. Frequency, Magnitude and Phase Response 3. Z – Transform 4. N – DFT 5. N-DFT Using Twiddle Matrix 6. Linear Convolution 7. Circular Convolution 8. Low – Pass FIR Filter 9. High – Pass FIR Filter 10. High-Pass and Low-Pass FIR Filter on various Inputs 11. Band-Pass and Band-stop FIR Filters 12. Analog Filters 13. Power Spectral Density 14. Remez Exchange Algorithm	**2**
PSCS-P3	**Mobile Applications using J2ME toolkit** 1. Create an application to draw simple text. 2. Create an application to draw simple text and perform various operations. 3. Create an application to handle multiple forms. 4. Create an application to demonstrate timers. 5. Create an application to demonstrate use of buffering (back and double). 6. Create an application to demonstrate bouncing ball in mobile application. 7. Create an application to demonstrate a simple Calculator. 8. Create an application to demonstrate different input boxes. 9. Create an application to demonstrate a dialog box. 10. Create an application to display the bitmap image. 11. Create an application to demonstrate various types of events. 12. Create an application for searching particular word in a text paragraph**.**	**2**
PSCS-P4	**Data warehousing and Data Mining** 1. Create OLAP cube using star and Snowflake schema. 2. Working with Measures in cube. 3. Firing queries on the cube by using MDX application 4. Data pre-processing and discretization 5. Classification problems 6. Clustering Analysis **7.** Association Rule Mining 8. Data visualization **Suggested Software:Data warehouse:** Microsoft SQL Server 2000.	**2**

	Data Mining: Practicals are conducted using Data mining 'workbench' software WEKA installed on Windows image. May be available under Linux. Freely downloadable from University of Waikato: http://www.cs.waikato.ac.nz/ml/weka/	

SEMESTER II

Paper V: Principles of Compiler Design-II: **CS 201**

PSCS201	I	Syntax-Directed Translation	**4**
	II	More about Translation Symbol Tables	
	III	Error detection and recovery	
	IV	Introduction to code, loop optimization and data-flow analysis	
	V	Code generation	

Paper VI: Digital Signal Processing-II: **CS 202**

PSCS202	I	An introduction to the theory of two dimensional signal processing and Digital hardware	**4**
	II	Special purpose hardware for digital filtering and signal generation	
	III	Special purpose hardware for FFT	
	IV	General Purpose hardware for signal Processing facilities	
	V	Application of Digital signal processing to Speech and Radar	

Paper VII: Computer Simulation & Modeling: **CS 203**

PSCS203	I	Introduction to Simulation, examples , Principles and Software	4
	II	Statistical and Queuing Models in Simulation	
	III	Random Number and Variate Generation	
	IV	Input Modeling and Verification and Validation of Simulation Model	
	V	Output Analysis for a single model, Comparison and Evaluation of Alternative System Design and Case Studies	

Paper VIII: Advanced database system: **CS 204**

PSCS204	I	Object Database Systems	4
	II	Parallel and Distributed Databases	
	III	Databases on the Web	

	IV	Active and Deductive Databases	
	V	Spatial and Temporal Databases	

Detail Syllabus
Semester II

Course Code	Title	Credits
PSCS201	**Principles of Compiler Design-II**	**4**

Unit I: Syntax-Directed Translation
Syntax-directed translation schemes, Implementation of syntax-directed translators, Intermediate code, Postfix notation, Parse trees and syntax trees, Three-address code, quadruples, and triples ,Translation of assignment statements, Boolean expressions, Statements that alter the flow of control, Postfix translations **[17L]**

Unit II: More about Translation and Symbol Tables
Array references in arithmetic expressions, Procedure calls, Declarations ,Case statements, Record structures, Symbol Tables:The contents of a symbol table, Data structures for symbol tables, Representing scope information, Implementation of block-structured languages, Storage allocation in FORTRAN, Storage allocation in block-structured languages **[12L]**

Unit III: Error detection and recovery
Errors, Lexical-phase errors, Syntactic-phase errors, Semantic errors **[03L]**

Unit VI: Introduction to code, loop optimization and data flow analysis
The principle sources of optimization, Loop optimization, The DAG representation of basic blocks, Global data-flow analysis ,loop optimization: Dominators, Reducible flow graphs, Depth-first search, Loop-invariant computations, Induction variable elimination ,Some other loop optimizations, Data-flow analysis, Reaching definitions again, Available expressions, Copy propagation, Backward flow problems, Very busy expressions and code hoisting, The four kinds of data-flow analysis problems. **[23L]**

Unit V: Code generation
Object programs, Problems in code generation, A machine model, A simple code generator, Register allocation and assignment, Code generation from DAG's
Peephole optimization **[05L]**

References:
Principles of Compiler Design, Alfred V. Aho & Jeffrey D. Ullman

Course Code	Title	Credits
PSCS202	**Digital Signal Processing -II**	**4**

Unit I: An introduction to the theory of two dimensional signal processing and Digital hardware:

Two-dimensional signals-systems-causality- seperability -stability-difference equations-Frequency Domain Techniques- Z Transforms-finite sequences-Two dimensional DFT-Two dimensional windows-Frequency sampling filters- frequency transformations from one to two dimensions. Digital Hardware: Design procedure for Digital Signal Processing Hardware- the major logic families- commercial logic packages- gates, multiplexers and decoders- Flip-Flops-arithmetic Units- dividers and floating point hardware. **[15L]**

Unit II: Special purpose hardware for digital filtering and signal generation: Direct form FIR hardware- parallelism for direct form FIR- Cascade FIR filters-IIR filters- Digital Touch Tone Receiver (TTR) - Digital time Division Multiplexing (TDM) to Frequency Division Multiplexing (FDM) translator partitioning of digital filters for IC Realization- Hardware realization of a Digital Frequency Synthesizer. **[10L]**

Unit III: Special purpose hardware for FFT : FFT indexing- bit reversal and digit reversal for fixed radices- Comparison of computations for radices- introduction to quantization effects in FFT Algorithms. Hardware for Radix 2 Algorithm- FFT Computation using Fast Scratch Memory.Radix 2 and Radix 4 Parallel structures using RAM's- Pipeline FFT- Comparison of Pipe line FFT's-overlapped FFT with random access memory-real time convolution via FFT using a single Ram and one AE. **[10L]**

Unit IV: General Purpose hardware for signal Processing facilities : Special and general purpose computers- input output problems for real time processing- methods of improving computer speed – parallel operations of memories, Arithmetic, control and instruction fetches- the Linco Laboratory Fast Digital Processor(FDP). Doing FFT in FDP- LSP2. **[10L]**

Unit V: Application of Digital signal processing to Speech and Radar:

Models of speech production-Short time spectrum analysis- speech analysis-synthesis System based on short time spectrum analysis- channel vocoder- analyzers-synthesizers- pitch detection and voiced unvoiced detections- homomorphic processing of speech, vocoder-formant Synthesis-Voiced –Unvoiced Detection- Voiced Fricative excitation network- Linear prediction of speech-Computer Voice Response system.

Radar: Radar principle and application radar systems and parameter- Signal design and ambiguity functions- Airborne Surveillance Radar for Air Traffic Control – Digital matched Filter for a high performance Radar. **[15L]**

References:

1) Theory and application of Digital signal processing Lawrence R. Rabiner Bernard Gold-prentice hall of India.
2) Digital Signal Processing and the Microcontroller by Dale Grover and John R. (Jack) Deller with illustrations by Jonathan Roth.

Course Code	Title	Credits
PSCS203	**Computer Simulation & Modeling [60 Lectures]**	**4**

Unit I: **Introduction to Simulation, examples , Principles and Software**

Introduction: System and System environment, Components of system, Type of systems, Type of models, Steps in simulation study, Advantages and Disadvantages of simulation. Examples: Simulation of Queueing systems, Other examples of simulation. General Principles: Concepts of discrete event simulation, List processing. Simulation Software: History of simulation software, Desirable software features, General-purpose simulation packages, Object oriented simulation, Trends in simulation software. **[16L]**

Unit II : **Statistical and Queuing Models in Simulation:**

Statistical Models: Useful statistical model, Discrete distribution, Continuous distribution, Poisson process, Empirical distribution. Queueing Models: Characteristics of Queueing systems, Queueing notations, Long run measures of performance of Queueing systems, Steady state behavior of infinite population Markovian models, Steady state behavior finite population model, Network of Queues. **[16L]**

Unit III Random Number and Variate Generation:

Random Number: Properties of random numbers, Generation of pseudo random numbers, Techniques for generating random numbers, Tests for random numbers. Random Variate Generation: Inverse transform technique, Convolution method, Acceptance rejection techniques. **[12L]**

Unit IV : Input Modeling and Verification and Validation of Simulation Model Input Modeling: Data Collection, Identifying the Distribution of data, Parameter estimation, Goodness of fit tests, Selection input model without data, Multivariate and Time series input models.Verification and Validation of Simulation Model: Model building, Verification, and Validation, Verification of simulation models, Calibration and Validation of models. **[07L]**

Unit V : Output Analysis for a single model, Comparison and Evaluation of Alternative System Design and Case Studies

Output Analysis for a Single Model: Types of simulations with respect to output analysis, Stochastic nature of output data, Measure of performance and their estimation, Output analysis of terminating simulators, Output analysis for steady state simulation. Comparison and Evaluation of Alternative System Design: Comparison of two system design, Comparison of several system design, Meta modeling, Optimization via simulation. Case Studies: Simulation of manufacturing systems, Simulation of computer systems, Simulation of super market, Simulation of pert network. **[09L]**

References:

1. Jerry Banks, John Carson, Barry Nelson, David Nicol, .*Discrete Event System Simulation*. [3rd Edition]
2. Averill Law, W. David Kelton, .*Simulation Modeling and Analysis.*, McGRAWHILL Geffery Gordon, .*System Simulation.*, PHI
3. Bernard Zeigler, Herbert Praehofer, Tag Gon Kim, .*Theory of Modeling and Simulation.*, Academic Press Narsing Deo, .*System Simulation with Digital Computer*., PHI
4. Donald W. Body, .*System Analysis and Modeling.*, Academic Press Harcourt India
5. W David Kelton, Randall Sadowski, Deborah Sadowski, .*Simulation with Arena*., McGRAW-HILL.

Course Code	Title	Credits
PSCS204	**Advanced Databases**	**4**

Unit I Object Database Systems :

Object-Oriented data model, Strategies for developing OODBMS, Persistence programming languages, Object identity and structure, complex objects, Accessing an object, Persistence Schemes, Pointer swizzling techniques, Issues in OODBMS like transactions and concurrency, ODMG, Nested relations, Collections, Query processing and Optimization. **[15L]**

Unit II: Parallel and Distributed Databases :

Architectures for parallel databases, Parallel query evaluation; Parallelizing individual operations, Sorting, Joins; Distributed database concepts, Data fragmentation, Replication, and allocation techniques for distributed database design; Query processing in distributed databases; Concurrency control and Recovery in distributed databases. **[15L]**

Unit III: **Databases on the Web:**

Data versus Documents, Storing and Retrieving Data, Query Languages like Xquery, Storing and Retrieving Documents, Semi Structured Data Model, Indexes for text data. **[10L]**

Unit IV: Active and Deductive Databases :

Active databases: Languages for rule specification: Events, Conditions, Actions. Execution model: Rule execution, Conflicts resolution, Coupling modes and termination.

Deductive databases: Introduction to recursive queries, Datalog, Least model semantics, The fixed point operator, Safe datalog program, Stratification, Evaluating recursive queries. **[10L]**

Unit: V: **Spatial and Temporal Databases :**

Spatial Databases: Types of spatial data, R tree structure, Spatial query evaluation, Introduction to GIS, Comparison between spatial databases and GIS. Data structures in GIS.

Temporal Databases: Transaction time databases, Valid time databases:, Bi-temporal databases, Temporal queries.

Introduction to Mobile databases. [10L]

References:

1. Raghu Ramakrishnan, Johannes Gehrke, "*Database Management Systems*", McGraw-Hill
2. Elmasri and Navathe, "*Fundamentals of Database Systems*", Pearson Education

Additional References:

1. Korth, Silberchatz, Sudarshan , "*Database System Concepts*", McGraw-Hill.
2. Peter Rob and Coronel, "*Database Systems, Design, Implementation and Management*", Thomson Learning.
3. C.J.Date, Longman, "*Introduction To Database Systems*", Pearson Education

PRACTICALS

At the end of Second Semester there will be a practical examination based on Theory PSCS 201, PSCS 202, PSCS 203 and PSCS 204.

PSCS-P5	1. Conversion of Infix to Postfix notation 2. Conversion of Postfix to Infix notation 3. Generation of three address code 4. Quadruple 5. Triple 6. DAG representation 7. Code generation	**2**
PSCS-P6	1. Two – Dimensional Linear Convolution 2. Two – Dimensional Cross – Correlation and Auto – Correlation 3. Stability 4. Bit Reversal Algorithm 5. Radix 2 DIT FFT Algorithm	**2**
PSCS-P7	**Computer Simulation and Modeling** 1. Single Channel Queuing Model 2. Multi Channel Queuing Model 3. Inventory System 4. Discrete Distribution 5. Continuous Distribution 6. Random Number Generation 7. Random Number Test 8. Acceptance-Rejection Technique	**2**
PSCS-P8	**Advanced Databases Practical topics** 8. Object oriented databases 9. Distributed databases 10. XML databases 11. Spatial databases 12. Temporal databases 13. Active databases **Software recommended :** Oracle.	**2**

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 **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 **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 ▪ Experimental Set up / Methodology used ▪ Understanding / Rigour/ Research component ▪ Results and conclusion ▪ Documentation ▪ Presentation of the Project	10 marks 20 marks 20 marks 20 marks 10 marks 20 marks
	Maximum Marks	100 marks