केन्द्रीय प्रौद्योगिकी संस्थान कोकराझार
CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR
(Deemed to be University, MHRD, Govt. of India)
BODOLAND TERRITORIAL AREA DISTRICTS :: KOKRAJHAR :: ASSAM :: 783370
Website: www.cit.ac.in

Department of Computer Science and Engineering

M.Tech. programme

Total Credit Points Requirements: **130**

Total Credit Hours Requirements: **95**

Total Number of Semesters: **4**

CURRICULUM BROCHURE

Curricula of courses running since the academic year 2019-20

1st YEAR: 1st SEMESTER (JULY-DEC)

1st Semester:								
	Code	Subjects	Contacts (periods per week)				Credit hours	Credit points
			L	T	P	Total		
1.	PCSE101	Mathematical Foundation in Computer Science	3	1	0	4	4	8
2.	PCSE102	Algorithms and Algorithmic Complexity	3	1	0	4	4	8
3.	PCSE103	Advanced DBMS	3	1	0	4	4	8
4.	PCSE11*	Elective-I	3	0	0	3	3	6
5.	PCSE171	Advanced Algorithms Lab	0	0	3	3	3	3
6.	PCSE172	Advanced DBMS Lab	0	0	3	3	3	3
7.	PCSE191	Seminar	0	0	2	2	2	2
Total							23	38

Total Credits of 1st Semester: 38

1st YEAR: 2nd SEMESTER (JAN-JUNE)

2nd Semester:								
	Code	Subjects	Contacts (periods per week)				Credit hours	Credit points
			L	T	P	Total		
1.	PCSE201	Advanced Computer Network	3	1	3	7	7	11
2.	PCSE202	Advanced Operating System	3	1	3	7	7	11
3.	PCSE21*	Elective -II	3	0	0	3	3	6
4.	PCSE21*	Elective -III	3	0	0	3	3	6
5.	PCSE291	Seminar	0	0	2	2	2	2
Total							22	36

Total Credits of 2nd Semester: 36

2nd YEAR: 3rd SEMESTER (JULY-DEC)

3rd Semester:								
	Code	Subjects	Contacts (periods per week)				Credit hours	Credit points
			L	T	P	Total		
1.	PCSE31*	Elective-IV	3	0	0	3	3	6
2.	PCSE31*	Elective-V	3	0	0	3	3	6
3.	PCSE391	Project Phase - I	0	0	16	16	16	16
4.	PCSE391	Seminar	0	0	0	2	2	2
Total							24	30

Total Credits of 3rd Semester: 30

2nd YEAR: 4th SEMESTER (JAN-JUNE)

4th Semester:								
	Code	Subjects	Contacts (periods per week)				Credit hours	Credit points
			L	T	P	Total		
1.	PCSE491	Project Phase - II	0	0	26	26	26	26
Total							26	26

Total Credits of 4th Semester: 26

Important note:

- 'L' - 2 credit points for 1 credit hours
- 'T' - 2 credit points for 1 credit hours
- 'P' - 1 credit point for 1 credit hour
- 'Seminar' - 1 credit point for 1 credit hour
- 'Project' - 1 credit point for 1 credit hour

Electives for M.Tech (CSE)

Odd Semester Elective courses list:

1st Semester:

1. PCSE111– Artificial Intelligence.
2. PCSE112– Automata Theory
3. PCSE113– Distributed Systems.
4. PCSE114– Embedded Systems and Real Time System.
5. PCSE115– Mobile and Pervasive Computing.
6. PCSE116– Natural Language Processing.
7. PCSE117– Object Oriented Programming and Design.
8. PCSE118– Remote Sensing and Digital Image Processing.

3rd Semester:

1. PCSE311– Advanced Cryptography and Information Security
2. PCSE312– Advanced Digital Image Processing.
3. PCSE313– Big Data Analytics.
4. PCSE314– Computational Biology.
5. PCSE315– High Performance Computing.
6. PCSE316– Information Retrieval.
7. PCSE317– Ubiquitous Computing.
8. PCSE318 - Software Defined Networking

Even Semester Elective courses list:

2nd Semester:

1. PCSE211– Cloud Computing.
2. PCSE212– Data Mining and Data Warehousing.
3. PCSE213– Human Computer Interaction.
4. PCSE214– Machine Learning.
5. PCSE215– Optimization Method.
6. PCSE216– Robotics and Computer Vision.
7. PCSE217– Soft Computing.
8. PCSE218 - Image Processing and Pattern Recognition

PROGRAMME CORE COURSES

PCSE101 Mathematical Foundation of Computer Science 3-1-0-8

UNIT -I: Mathematical Logic:

Propositional Calculus: Statements and Notations, Connectives, Well-Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof. Predicate Calculus:Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

UNIT -II: Set Theory:

Introduction, Operations on Binary Sets, Principle of Inclusion and Exclusion, Relations: Properties of Binary Relations, Relation Matrix and Digraph, Operations on Relations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering Relations, Hasse Diagrams, Functions: Bijective Functions, Composition of Functions, Inverse Functions, Permutation Functions, Recursive Functions, Lattice and its Properties.

UNIT- III: Algebraic Structures and Number Theory:

Algebraic Structures: Algebraic Systems, Examples, General Properties, Semi Groups and Monoids, Homomorphism of Semi Groups and Monoids, Group, Subgroup, Abelian Group, Homomorphism, Isomorphism, Number Theory: Properties of Integers, Division Theorem, The Greatest Common Divisor, Euclidean Algorithm, Least Common Multiple, Testing for Prime Numbers, The Fundamental Theorem of Arithmetic, Modular Arithmetic (Fermat‘s Theorem and Euler‘s Theorem)

UNIT -IV: Combinatorics:

Basic of Counting, Permutations, Permutations with Repetitions, Circular Permutations, Restricted Permutations, Combinations, Restricted Combinations, Generating Functions of Permutations and Combinations, Binomial and Multinomial Coefficients, Binomial and Multinomial Theorems, The Principles of Inclusion Exclusion, Pigeonhole Principle and its Application.

UNIT -V: Recurrence Relations:

Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations

UNIT -VI: Graph Theory:

Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, Multigraphs, Planar Graphs, Euler‘s Formula, Graph Colouring and Covering, Chromatic

Number, Spanning Trees, Algorithms for Spanning Trees (Problems Only and Theorems without Proofs).

Text & Reference Books:

1. Lawvere and Bosebrugh, Sets for Mathematics, Cambridge.
2. Sheldon Axler, Linear Algebra Done Right, Springer
3. Michael Artin, Algebra, Prentice-Hall India.
4. RP Stanley. Enumerative Combinatorics, Cambridge.
5. I Anderson, Combinatorics of Finite Sets, Oxford Science Publications.
6. B. Bollobas, Combinatorics, Cambridge.
7. JH van Lint and RM Wilson, A course in Combinatorics, Cambridge.
8. S Jukna. Extremal Combinatorics. Springer.

PCSE102 ALGORITHMS AND ALGORITHMIC COMPLEXITY 3-1-0-8

Review: Fundamentals of Algorithmic: Classification of Problems, Complexity, Asymptotic Notations, Amortized analysis

Recurrences: Master Theorem Probabilistic Analysis: Sort, Search, Random Binary Search trees, Red-black trees, Priority Queues - Binary heaps, Binomial heaps, Bipartite Matching, Common Subsequence Problem, Flow Networks, Ford-Fulkerson Method, Knuth-Morris-Pratt Algorithm.

Algorithm design techniques: Divide and conquer, Dynamic programming, Greedy method

Data compression algorithms: Huffman compression, Lempel-Ziv compression

Approximation Algorithms: Concept, Design, Applications. Inapproximability.

Number-Theoretic Algorithms: RSA data encryption, Primality testing

NP completeness: Polynomial-time reductions, Cooke's theorem

Text & Reference Books:

1. Introduction to Algorithms - T. H. Cormen, et al. (PHI, 1990)

2. Algorithms for Hard Problems - J. Hromkovic (Springer)

3. Anany V. Levitin, Introduction to the Design and Analysis of Algorithms, Addison Wesley

PCSE103 Advanced DBMS 3-1-0-8

Objective

- To understand the basic concepts and terminology related to DBMS and Relational Database Design
- To the design and implement Distributed Databases.
- To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports

Unit I
Formal review of relational database and FDs Implication, Closure, its correctness

Unit II
3NF and BCNF, Decomposition and synthesis approaches, Review of SQL99, Basics of query processing, external sorting, file scans

Unit III
Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, serialisability

Unit IV
Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC

Unit V
T/O based techniques, Multiversion approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases.

Outcome

- Exposure for students to write complex queries including full outer joins, self-join, sub queries, and set theoretic queries.
- Knowhow of the file organization, Query Optimization, Transaction management, and database administration techniques

Text Books

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
2. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.

Reference Books

1. K. V. Iyer, Lecture notes available as PDF file for classroom use.

PCSE172 Advanced DBMS Lab 0-0-3-3

Objective:

- To explore the features of a Database Management Systems
- To interface a database with front end tools
- To understand the internals of a database system

Experiments

- Basic SQL
- Intermediate SQL
- Advanced SQL
- ER Modeling
- Database Design and Normalization
- Accessing Databases from Programs using JDBC
- Building Web Applications using PHP & MySQL
- Indexing and Query Processing
- Query Evaluation Plans
- Concurrency and Transactions
- Big Data Analytics using Hadoop

Outcome:

- Ability to use databases for building web applications.
- Gaining knowledge about the internals of a database system.

References

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", 6th edition, Tata McGraw Hill, 2011
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 4th Edition, Pearson/Addision wesley, 2007

PCSE201 Advanced Computer Network 3-1-0-8

Internet Design & Architecture: Overview of network building blocks, Network architecture, layers and protocols, Internet design: Challenges and Solutions

Basic Protocols: Overview of IPv4, TCP, IPv6, ICMP, ARP, DHCP;

Routing Protocols: OSPF, RIP, BGP, Ad hoc network routing (AODV, DSR);

Traffic Management: Congestion control principles, TCP congestion control, Traffic Engineering Principles, MPLS Routing

Software Defined Networks (SDNs): SDN Controllers, Network Programmability, Network Function Virtualization, SDN Frameworks, Use cases for traffic monitoring & classification, bandwidth scheduling and monitoring

Wireless Networks: Wireless Networks fundamentals, Mobile IP and Micromobility Protocols, TCP performance in Wireless Networks

IP Security: NAT, IPSEC, SSL

Text books :

1. Kurose James F and Keith W. Ross: Computer Networking: A Top-Down Approach Featuring the Internet
2. Adolfo Rodriguez, et. al, TCP/IP Tutorial and Technical Overview, IBM Redbook, available online at http://www.redbooks.ibm.com/pubs/pdfs/redbooks/gg243376.pdf, 2001.

Reference Books:

1. Charles. M.Kozierek, TCP/IP Guide, Shroff Publishers, Mumbai, 2005.
2. Uyless Black, MPLS and Label Switching Networks, Pearson Education (LPE), 2002.

PCSE202 ADVANCED OPERATING SYSTEMS 3-0-0-6

Study of major Operating System issues such as:

- Memory Management,
- Process Management and Scheduling,
- File Systems,
- Networking by looking at the internals of actual systems such as Unix, Linux, NT etc.
- Issues in design of distributed operating systems.
- Selected case studies such as Amoeba, Chorus, Mach etc.

Text Books:

1. B. Goodheart and J. Cox, The Magic Garden Explained: The Internals of Unix System V Release 4, Prentice Hall 1994.
2. M. K. McKusick et al., The Design and Implementation of the 4.4 BSD Operating System, Addison Wesley, 1996.
3. U. Vahalia, Unix Internals: The New Frontiers, Prentice Hall, 1996.
4. P. K. Sinha, Distributed Operating Systems, Wiley-IEEE Press, 1996.
5. H. Custer, Inside Windows NT, 2nd Ed, Microsoft Press, 1998.
6. Selected papers and reports and source code.

PCSE271 ADVANCED OPERATING SYSTEMS LAB 0-0-3-3

Experiments would be designed to provide hands-on experience in computer systems, to learn unix system calls, posix threads, operating system concepts, network programming and simulations.

Texts & References Books:

1. W. R. Stevens, UNIX Network Programming, Volume 1: Networking APIs: Sockets and XTI, Prentice Hall, 1998.
2. W. R. Stevens, UNIX Network Programming, Volume 2: Interprocess Communications, Prentice Hall, 1999.
3. W. R. Stevens, Advanced Programming in the UNIX Environment, Addison Wesley, 1992.

ELECTIVE COURSES

PCSE317 UBIQUITOUS COMPUTING 3-0-0-6

Introduction, Overview, Challenges

Networking Basics, NFC, Wireless LAN

Location in ubiquitous computing: Personal assistants, Location aware computing, Location tracking, Architecture, Location based service and applications, Location based social networks (LBSN), LBSN Recommendation

Context-aware computing: Context and Context-aware Computing, Issues and Challenges, Developing Context-aware Applications, System Architecture

Privacy and security in ubiquitous computing

Energy constraints in ubiquitous computing

Wearable computing, Glass and Augmented Reality, Eye-Tracking, Digital Pen and Paper

Mobile social networking & crowd sensing, Event based social network

Mobile affective computing: Human Activity and Emotion Sensing, Health Apps

Mobile p2p computing

Smart Homes and Intelligent Buildings, Mobile HCI

Introduction to IoT

Definition, trend, IOT components, IOT Applications

Cloud centric IOT, Open challenges, Architecture, Energy Efficiency, Participatory sensing, New Protocols, QoS, QoE

IoT and data analytics IOT and Data Management, Data cleaning and processing, Data storage models Search techniques, Deep Web, Semantic sensor web, Semantic Web Data Management, Searching in IOT

Real-time and Big Data Analytics for The Internet of Things, Heterogeneous Data Processing, High-dimensional Data Processing, Parallel and Distributed Data Processing

Text Books:

- Ubiquitous Computing Fundamentals, John Krumm, CRC Press, 2010

PCSE311 Advanced Cryptography and Network Security 3-0-0-6

Principles of Security, Basic Cryptographic techniques,

Classification of attacks, Virus, Worm, Trojan Horse, Spam etc.

Symmetric Key Cryptography: Algorithm types and modes, Cryptographic Algorithms Asymmetric Key Cryptographic Algorithms, Digital Signature Digital Envelope, Message Authentication Code, Message Digest Public-Key Infrastructure (PKI) Authentication: Classifications, Mutual authentication Algorithms,

Kerberos Security in layers and domains: IPsec, Secure Socket Layer (SSL), E-mail Security Electronic transactions

Books:

1. Cryptography and Network Security: rinciples & Practices: William Stallings, 4th Edition Pearson & Prentice Hall
2. Network Security: Kaufman, Perlman, Speciner, Pearson Education
3. Papers from the ACM and IEEE digital libraries

PCSE217 SOFT COMPUTING 3-0-0-6

UNIT	Contents	Hours
I	Soft Computing: Introduction, requirement, different tools and techniques, usefulness and applications.	2
II	Fuzzy sets and Fuzzy logic: Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.	6
III	Artificial Neural Network: Introduction, basic models, Hebb's learning, Adaline, Perceptron, Multilayer feedforward network, Backpropagation, Different issues regarding convergence of Multilayer Perceptron, Competitive learning, Self-Organizing Feature Maps, Adaptive Resonance Theory, Associative Memories, Recurrent Networks, RBF Network, Different Design issues, Applications.	8
IV	Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of GA, analysis of selection operations, Hypothesis of building blocks, Schema theorem and convergence of Genetic Algorithm, Simulated annealing and Stochastic models, Boltzmann Machine, Applications.	6
V	Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications.	4
VI	Hybrid Systems: Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.	6
	Total hours	32

Text and Reference Books:

1. Neural Fuzzy Systems, Chin-Teng Lin & C. S. George Lee, Prentice Hall PTR.
2. Fuzzy Sets and Fuzzy Logic, Klir & Yuan, PHI, 1997.
3. Neural Networks, S. Haykin, Pearson Education, 2ed, 2001.
4. Genetic Algorithms in Search and Optimization, and Machine Learning, D. E. Goldberg, AddisonWesley, 1989.
5. Neural Networks, Fuzzy logic, and Genetic Algorithms, S. Rajasekaran & G. A. V. Pai, PHI.
6. Neuro-Fuzzy and Soft Computing, Jang, Sun, & Mizutani, PHI
7. Learning and Soft Computing, V. Kecman, MIT Press, 2001.
8. Rough Sets, Z. Pawlak, Kluwer Academic Publisher, 1991.
9. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997.
10. Papers from the ACM and IEEE digital libraries

ARTIFICIAL INTELLIGENCE

1. Subject Code**: PCSE111**

2. Course Title**: Artificial Intelligence**

3. Contact Hours: **L:3 T:0 P:0**

4. **Credits: 06**

5. Semester: **Autumn Spring (July-Dec)**

6. Pre-requisite**: Data Structure and algorithms**

7. Objective: **To acquaint the students with the theoretical and computational techniques in**

Artificial Intelligence.

8. Details of the Course:

UNIT	Contents	Hours
I	**Introduction**: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	**3**
II	**Searching:** Searching for solutions, **uniformed search strategies** – Breadth first search, depth first search, Depth limited search, Iterative deepening depth first search bi-direction search - comparison. **Search with partial information (Heuristic search**) Greedy best first search, A* search, Memory bounded heuristic search, Heuristic functions. **Local search Algorithms**, Hill climbing, simulated, annealing search, local beam search, genetic algorithms.	**8**
III	**Game Playing**: Adversial search, Games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions, cutting of search.	**5**
IV	**Knowledge Representation & Reasons logical Agents**, Knowledge – Based Agents, the Wumpus world, logic, propositional logic, Resolution patterns in propositional logic, Resolution, Forward & Backward Chaining. **First order logic**. Inference in first order logic, propositional Vs. first order inference, unification & lifts, forward chaining, Backward chaining, Resolution.	**9**
V	**Planning** – Classical planning problem, Language of planning problems, Expressiveness and extension, planning with state – space search, Forward states spare search, Backward states space search, Heuristics for stats space search. Planning search, planning with state space search, partial order planning Graphs.	**2**
VI	**Learning** – Forms of learning, Induction learning, Learning Decision Tree, Statistical learning methods, learning with complex data, learning with Hidden variables – The EM Algorithm, Instance Based learning, Neural Networks.	**4**
VII	**Advanced Topics:** Introduction to Natural language processing and expert systems	**1**
	Total hours	**32**

Text Books:

T1. *Artificial Intelligence – A Modern Approach. Second Edition, Stuart Russel, Peter Norvig, PHI/Pearson Education.*

T2. *Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition.*

Reference books:

R1. *Artificial Intelligence , 2nd Edition, E.Rich and K.Knight (TMH).*

R2. *Artificial Intelligence and Expert Systems – Patterson PHI.*

R3. *Expert Systems: Principles and Programming- Fourth Edn, Giarrantana/ Riley, Thomson.*

R4. *PROLOG Programming for Artificial Intelligence. Ivan Bratka- Third Edition – Pearson Education.*

Object Oriented Programming and Design

1. Subject Code**: PCSE117**

2. Course Title**: Object Oriented Programming and Design**

3. Contact Hours: **L:3 T:0 P:0**

4. **Credits: 06**

5. Semester: **Autumn Spring (July-Dec)**

6. Pre-requisite**: Object Oriented Programming**

7. Objective: **To acquaint the students with the theoretical and design techniques**

8. Details of the Course:

UNIT	Contents	Hours
I	**Introduction to UML:** Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, Software Development Life Cycle.	4
II	**Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages.	6
III	**Class & Object Diagrams:** Terms, concepts, modeling techniques for Class & Object Diagrams.	3
IV	**Basic Behavioral Modeling-I**: Interactions, Interaction diagrams.	2
V	**Basic Behavioral Modeling-II**: Use cases, Use case Diagrams, Activity Diagrams.	3
VI	**Advanced Behavioral Modeling**: Events and signals, state machines, processes and Threads, time and space, state chart diagrams.	4
VII	Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams. Case Study: The Unified Library application.	4
	Total hours	26

TEXT BOOKS :

1. Grady Booch, James Rumbaugh, Ivar Jacobson : The Unified Modeling Language User Guide, Pearson Education.

2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado: UML 2 Toolkit, WILEY-Dreamtech India Pvt. Ltd.

REFERENCE BOOKS:

1. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.

2. Pascal Roques: Modeling Software Systems Using UML2, WILEY-Dreamtech India Pvt. Ltd.

3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.

4. Mark Priestley: Practical Object-Oriented Design with UML,TATA McGrawHill

5. Appling UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.

Robotics and Computer Vision

1. Subject Code**: PCSE216**
2. Course Title**: Robotics and Computer Vision**
3. Contact Hours: **L:3 T:0 P:0**
4. **Credits: 06**
5. Semester: **(Jan- June)**
6. Pre-requisite**: Mathematics, Control system & Image processing**
7. Objective: **To acquaint the students with the theoretical and design techniques**
8. **Details of the Course:**

The scope of industrial Robotics – Definition of an Industrial Robot – Need for Industrial Robots – Applications – Fundamentals of Robot Technology – Automation and Robotics – Robot Anatomy – Work Volume – Precision of movement End effectors – Sensors.

Robot Programming – Methods – Interlocks textual languages – Characteristics of Robot level languages, characteristics of task level languages.

Puma Robot Arm Control – Computed Torque Technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Reserved motion control – Adaptive control.

Robot Cell Design and control – Remote center Compliance – Safety in Robotics.
Advanced Robotics, Advanced Robotics in Space – Specific features of Space Robotics systems -

Long term technical developments – Advanced Robotics in underwater operations – Robotics Technology of the future – Future applications.

Digital image fundamentals, digitization and 2-D parameters, types of operation; Basic tools: Convolution, Fourier transforms and statistical approaches**.**

Image analysis and processing, basic enhancement and restoration techniques, unsharp masking, noise suppression, distortion suppression, segmentation, thresholding, edge finding, binary
mathematical morphology, grey-value mathematical morphology.

TEXT BOOK:

1. Barry Leatham Jones, “Elements of Industrial Robotics” Pitman Publishing, 1987.
2. Pratt, W.K., “**Digital Image Processing**”, 2nd Ed., John Wiley & Sons, 1991

REFERENCE:

1. *Mikell P. Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming And Applications", McGraw Hill Book Company, 1986.*
2. *Fu K.S., Gonzalez R.C and Lee C.S.G., "Robotics – Control, Sensing, Vision and Applications", McGraw Hill International Editions, 1987.*
3. *Bernard Hodges and Paul Hallam, "Industrial Robotics", British Library Cataloging in Publication, 1990.*

Data Mining & Data Warehousing

1. Subject Code**: PCSE212**
2. Course Title**: Data Mining & Data Warehousing**
3. Contact Hours: **L:3 T:0 P:0**
4. **Credits: 06**
5. Semester: **(Jan- June)**
6. Pre-requisite**: DBMS and Statistics**
7. Objective: **To acquaint the students with the theoretical and design techniques**
8. **Details of the Course:**

UNIT	Contents	Hours
I	Overview, Motivation (for Data Mining), Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data,(Binning, Clustering, Regression, Computer and Human inspection),Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation	**3**
II	Concept Description:- Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases, Association rule mining, mining Single-Dimensional Boolean Association rules from Transactional Databases– Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multi-Dimensional Association rules from Relational Databases	**5**
III	*Classification and Predictions:* What is Classification & Prediction, Issues regarding Classification and prediction, Decision tree, Bayesian Classification, Classification by Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods K-nearest neighbor classifiers, Genetic Algorithm.	**8**
IV	*Cluster Analysis*: Data types in cluster analysis, Categories of clustering methods, Partitioning methods. Hierarchical Clustering- CURE and Chameleon, Density Based Methods-DBSCAN, OPTICS, Grid Based Methods-STING, CLIQUE, Model Based Method –Statistical Approach, Neural Network approach, Outlier Analysis	**10**
V	*Data Warehousing*: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3 Tier Architecture, Data Marting.	**4**

VI	Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.	**4**
	Total hours	**34**

Text Books :

1. Jiawei Han, Micheline Kamber, "**Data Mining Concepts & Techniques**" Elsevier

References Books:

1. M.H.Dunham,"**Data Mining:Introductory and Advanced Topics**" Pearson Education
2. Sam Anahory, Dennis Murray, "**Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems**", Pearson Education
3. Mallach,"**Data Warehousing System**",McGraw –Hill
4. Arun K. Pujari "**Data Mining Techniques**", Universities Press, 01-Jul-2001

IMAGE PROCESSING AND PATTERN RECOGNITION

1. Subject Code**: PCSE218**

2. Course Title**: IMAGE PROCESSING AND PATTERN RECOGNITION**

3. Contact Hours: **L:3 T:0 P:0**

4. **Credits: 06**

5. Semester: **(Jan- June)**

6. Pre-requisite**: Signal Processing and Statistics**

7. Objective: **To acquaint the students with the conceptual and theoretical knowledge of image**

processing and Pattern recognition

8. **Details of the Course:**

Unit	Contents	Hours
I	**Basic Concepts:** Pattern Recognition Systems, Fundamental Problems in pattern recognition system design, Design concepts and Methodologies: Character recognition, Speech recognition, Finger print Recognition. Pattern Recognition Model	
II	**Decision Functions:** Linear Decision functions, Distance functions. Minimum distance and Maximum distance classification, clustering concepts, Cluster seeking algorithms, K- means Algorithms	
III	**Baye's Classifier:** Baye's classified decision function for Baye's classifier, Baye's Classifier for normal patterns. Trainable pattern classifiers — deterministic approach, perception, and approach - reward— punishment concept	
IV	**Gradient Approach:** Gradient approach, Gradient Descent algorithms, LMSE Algorithms, Multi category classification.	
V	**Trainable Pattern Classifiers** Trainable pattern classifiers, statistical approach, stochastic approximation methods, Robbin Minro algorithms, increment correction algorithms, LMSE algorithms. Syntactic patter recognition, formulation — syntax directed recognition — picture descript.	
VI	**Digital Image Fundamentals** A simple image model, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images.	
VII	**Bilevel Image Processing** Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morpho-logical processing, extension to grey scale morphology.	
VIII	**Binarization and Segmentation of Grey Level Images** Histogram of grey level images, Optimal thresholding using Bayesian classification, multilevel thresholding, Segmentation of grey level images, Water shade algorithm for segmenting grey level image.	
IX	**Detection of Edges and Lines in 2d Images** First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.	

X	**Images Enhancement** Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration.	

Text Books:

1. R.C.Gonzalez and R.E.Wood, **Digital Image Processing**, Addison Wesley.
2. J.T. Tou, R.C. Gonzalez, **Pattern Recognition Principles**, Addison Wesley.
3. Anil Ku Jain, **Fundamentals of Digital Image Processing**, PHI.

References Books :

1. S. Theodoridis and K. Koutroumbas, **Pattern Recognition**, 4th Edition, Academic Press, 2009.demic Press, 2002.
2. B.Channda and D.Dutta, **Digital Image Processing and Analysis**, Prentice Hall.
3. Richard O. Duda, Peter E. Hart and David G. Stork, **Pattern Classification**, 2nd Edition, John Wiley, 2006.
4. C. M. Bishop, **Pattern Recognition and Machine Learning**, Springer, 2009.

Remote Sensing and Digital Image Processing

1. Subject Code**: PCSE118**
2. Course Title**: Remote Sensing and Digital Image Processing**
3. Contact Hours: **L:3 T:0 P:0**
4. **Credits: 06**
5. Semester: **(July-Dec)**
6. Pre-requisite**: image processing**
7. Objective: **To introduce the concepts of Remote Sensing and Digital Image Processing**
8. **Details of the Course:**

UNIT	Contents	Hours
I	**Introduction:** History of Remote Sensing, Remote sensing components, Sources of Energy, EMS and Radiation, Black body and associated laws Interaction of EMR with Atmosphere—Scattering, Refraction, Absorption, Transmission, Atmospheric windows, Interaction of EMR with Earth Surface—Spectral reflectance curves, Radiation Calculation,	4
II	**Platforms and Sensors:** Orbit al movement and Earth coverage. Sun synchronous and Geosynchronous satellites, Active and passive sensors, PAN, Multi High resolution and Hyper spectral Sensors, Thermal and Microwave sensors, Sensors characteristics, Indian Remote Sensing Satellite Programme, Other satellites	6
III	Image compression, Pixel and sub-pixel level target detection and classification, Data fusion methods and applications.	5
IV	DEM generation from stereo-satellite images, CARTOSAT DEM, SRTM DEM, ASTER DEM, Parameter extraction	5
V	Empirical modelling of biophysical parameters from multi and hyperspectral remote sensing data, 3D visualisation of data	8
VI	ANN, Fuzzy Logic, Object based classification from satellite images	8
VII	**Applications** of multi and hyperspectral remote sensing data in water resources, forestry, earth sciences, resource management and planning, military target detection.	6
	Total	**42**

Suggested Books:

1) Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, “Remote Sensing and Image Interpretation”, 7th Edition, Wiley, 2015.
2) Chen, C.H., “Information Processing for Remote Sensing”, World Scientific. 1999.
3) Landgrebe, D., “Signal Theory Methods in Multi-spectral Remote Sensing”, John Wiley. 2003
4) Richards, John A. and Xiuping, Jia., “Remote Sensing Digital Image Analysis : An Introduction”, Springer-Verlag. 1999.

Advanced Digital Image Processing

1. Subject Code**: PCSE312**
2. Course Title**: Advanced Digital Image Processing**
3. Contact Hours: **L:3 T:0 P:0**
4. **Credits: 06**
5. Semester: **(July-Dec)**
6. Pre-requisite**: Remote Sensing and Digital Image Processing**
7. Objective: **To introduce the concepts of multi and hyper-spectral remote sensing**.
8. **Details of the Course:**

UNIT	Contents	Hours
I	**Various types of images:** PAN, Multispectral, Hyperspectral and High resolution images, Feature and intensity based image registration of images, Open Source Image Processing software and image data	4
II	**Advanced Spatial Filtering techniques:** Spatial and Frequency domain (e.g., Fourier, wavelets), Texture Images	6
III	Image compression, Pixel and sub-pixel level target detection and classification, Data fusion methods and applications.	5
IV	DEM generation from stereo-satellite images, CARTOSAT DEM, SRTM DEM, ASTER DEM, Parameter extraction	5
V	**Empirical modelling** of biophysical parameters from multi and hyperspectral remote sensing data, 3D visualisation of data	8
VI	ANN, Fuzzy Logic, Object based classification from satellite images	8
VII	**Applications** of multi and hyperspectral remote sensing data in water resources, forestry, earth sciences, resource management and planning, military target detection.	6
	Total	**42**

List of Practical's:

1. Study of different types of remote sensing data
2. Hands on experience on images processing modules
3. Data visualization tools – study of images
4. Feature and intensity based image registration of images
5. Spatial enhancement of remote sensing images
6. Data dimensionality reduction using feature selection and feature extraction methods
7. Advanced pattern recognition algorithms for extraction of information from images
8. Derivation of biophysical parameters from multi and hyperspectral remote sensing images

Suggested Books:

5) Chen, C.H., "Information Processing for Remote Sensing", World Scientific. 1999.
6) Cheng, Chein I., "Hyperspectral Imaging : Techniques for Spectral Detection and Classification", Kluwer Academic. 2003
7) Landgrebe, D., "Signal Theory Methods in Multi-spectral Remote Sensing", John Wiley. 2003
8) Richards, John A. and Xiuping, Jia., "Remote Sensing Digital Image Analysis : An Introduction", Springer-Verlag. 1999
9) Varshney, P.K. and Arora, Manoj K., "Advanced Image Processing Techniques for Hyperspectral Remote Sensing Data", Springer-Verlag. 2004

PCSE112 **Automata Theory** **3-0-0-6**

UNIT	Contents	Hours
I	Automata and Languages: finite automata and regular expressions, pushdown automata and context-free grammars	4
II	pumping lemmas and closure properties of regular and context-free languages, non-context-free languages;	4
III	Computability theory: the Church-Turing thesis, Hilbert's problem, decidability, halting problem, reducibility	6
IV	Complexity theory: time and space complexity, Classes P, NP, NP-complete, PSPACE, and PSPACE-complete	3
V	Intractability: hierarchy theorem, Relativization, Circuit complexity	3
	Total hours	20

TEXT BOOK:

1. Barry Leatham Jones, "Elements of Industrial Robotics" Pitman Publishing, 1987.
2. Pratt, W.K., "**Digital Image Processing**", 2nd Ed., John Wiley & Sons, 1991

PCSE116 Natural Language Processing 3-0-0-6

Introduction- Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes.

Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc.

Resource management with XML, Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF. Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions.

A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.

Parsing- Unification, probabilistic parsing, TreeBank. Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet Word Sense Disambiguation- Selectional restriction, machine learning approaches, and dictionary based approaches. Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure. Applications of NLP- Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.

Machine Translation– Overview.

PCSE214 Machine learning 3-0-0-6

Introductory Topics: What is machine learning, why machine learning, Machine learning vs Conventional Algorithm

Linear Regression and Feature Selection

Linear Classification, Bayesian Learning and Decision Trees, Hidden Markov Model, Support Vector Machines and Artificial Neural Networks

Evaluation Measures

Hypothesis Testing

Ensemble Methods

Clustering

Graphical Models

Learning Theory and Expectation Maximization

PCSE314 Computational Biology 3-0-0-6

Molecular sequences, Genome sequencing: pipeline and data, Next generation sequencing data, Biological databases: Protein and Nucleotide databases, Sequence Alignment, Dynamic Programming for computing edit distance and string similarity, Local and Global Alignment, Needleman Wunsch Algorithm, Smith Waterman Algorithm, BLAST family of programs, FASTA algorithm, Functional Annotation, Progressive and Iterative Methods for Multiple sequence alignment, Applications.

Introduction to Phylogenetics, Distance and Character based methods for phylogenetic tree construction: UPGMA, Neighbour joining, Ultrametric and Min ultrametric trees, Parsimonous trees, Additive trees, Bootstrapping.

Protein Structure Basics, Visualization, Prediction of Secondary Structure and Tertiary Structure, Homology Modeling, Structural Genomics, Molecular Docking principles and applications, Molecular dynamics simulations.

Machine learning techniques: Artificial Neural Networks and Hidden Markov Models: Applications in Protein Secondary Structure Prediction and Gene Finding, Introduction to Systems Biology and its applications in whole cell modelling, Microarrays and Clustering techniques for microarray data analysis, informatics in Genomics and Proteomics, DNA computing.

Variables, Data types, control flow constructs, Pattern Matching, String manipulation, arrays, lists and hashes, File handling, Programs to handle biological data and parse output files for interpretation

PCSE316 Information Retrieval 3-0-0-6

Introduction - History of IR - Components of IR - Issues – Open source Search engine Frameworks - The impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine - Characterizing the web

Boolean and vector-space retrieval models - Term weighting - TF-IDF weighting - cosine similarity – Preprocessing - Inverted indices - efficient processing with sparse vectors – Language Model based IR - Probabilistic IR – Latent Semantic Indexing - Relevance feedback and query expansion.

Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - meta-crawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression – XML retrieval

Link Analysis – hubs and authorities – Page Rank and HITS algorithms - Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & Map Reduce - Evaluation - Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling “invisible” Web - Snippet generation, Summarization, Question Answering, Cross-Lingual Retrieval

Information filtering; organization and relevance feedback – Text Mining - Text classification and clustering - Categorization algorithms: naive Bayes; decision trees; and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).

PCSE215 Optimization Method 3-0-0-6

UNIT	Contents	Hours
I	Introduction to Operation Research: Operation Research approach, scientific methods, introduction to models and modeling techniques, general methods for Operation Research models, methodology and advantages of Operation Research, history of Operation Research.	3
II	Linear Programming (LP): Introduction to LP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming, Integer linear programming.	6
III	Transportation & Assignment Problems: Introduction to Transportation problems, various methods of Transportation problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems.	3
IV	Network Analysis: Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.	3
V	Sequencing: Introduction, processing N jobs through two machines, processing N jobs through three machines, processing N jobs through m machines.	2
VI	Inventory Model: Introduction to inventory control, deterministic inventory model, EOQ model with quantity discount.	2
VII	Queuing Models: Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process.	3
VIII	Replacement & Maintenance Models: Replacement of items, subject to deterioration of items subject to random failure group vs. individual replacement policies.	3
	Total hours	25