PANDIT DEENDAYAL PETROLEUM UNIVERSITY, GANDHINAGAR
SCHOOL OF TECHNOLOGY

COURSE STRUCTURE FOR B TECH IN COMPUTER ENGINEERING													
Semester VII			**B Tech in Computer Engineering**										
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**					**Examination Scheme**					
								Theory			**Practical**		**Total**
			L	**T**	**P**	**C**	**Hrs/Wk**	**CE**	**MS**	**ES**	**CE**	**ES**	**Marks**
1	19CP401	Optimization Techniques	3	0	0	3	3	25	25	50	-	-	100
2	19CP402T	Machine Learning	4	0	0	4	4	25	25	50	-	-	100
3	19CP403	Internet of Things	3	0	0	3	3	25	25	50	-	-	100
4	19CP404P	Mini Project	0	0	14	7	14	-	-	-	Three reviews (30, 30 and 40 marks)		100
5	19XX40X	Elective III*	3	0	0	3	3	25	25	50	-	-	100
6	19XX40X	Elective IV*	3	0	0	3	3	25	25	50	-	-	100
7	19CP402P	Machine Learning Lab	0	0	2	1	2	-	-	-	25	25	50
		Total	16	0	16	24	32						650

CE- Continuous Evaluation, MS-Mid Semester; ES – End Semester Exam

*The department may offer electives from below basket, based on availability of expertise/faculty

Subject Code	Elective III* & Elective IV*	Credit	L-T-P	Category
19CP405	Cloud Computing	3	3-0-0	Computing System
19CP406	Advanced Operating System	3	3-0-0	Computing System
19IC403	Image Processing	3	3-0-0	Communication and Signal Processing
19CP407	Data Compression	3	3-0-0	Communication and Signal Processing
19CP408	Biometrics	3	3-0-0	Security
19IC404	Fundamentals of Remote Sensing	3	3-0-0	Communication and Signal

				Processing
19IC405	Computer Vision	3	3-0-0	Communication and Signal Processing
19CP409	Big Data Analytics	3	3-0-0	Data Science
19CP4010	Software Testing Methodologies	3	3-0-0	Computing System
19IC406	Vehicular Networks	3	3-0-0	Communication and Signal Processing
19CP4011	Cyber Security	3	3-0-0	Security
19IC4010	ICT for Energy Sector	3	3-0-0	Application
19CP4012	Human Computer Interaction	3	3-0-0	Application
19IC4011	Statistical Pattern Recognition	3	3-0-0	Data Science
19CP4013	Information Retrieval System	3	3-0-0	Data Science
19CP4014	Blockchain Technology	3	3-0-0	Security
19CP4015	Green Computing	3	3-0-0	Application

Course Code: 19CP401					**Course Name: Optimization Techniques**			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/ Wk**	**Theory**			**Total**
					Continuous Evaluation	**Mid Semester**	**End Semester**	**Marks**
3	0	0	3	3	25	25	50	100

Prerequisites: Mathematics

Learning objectives:

1. To introduce the basic concepts of Optimization Techniques
2. To apply the optimization techniques using both linear and non-linear programming
3. To frame engineering minima maxima problems in the framework of optimization problems
4. To introduce various metaheuristic techniques.

Unit wise allocation of course content

UNIT 1 (10 L): Introduction to Optimization: Mathematical formulation, Classification of optimization problems, Engineering applications of optimization. **Classical Optimization Techniques -** Single variable optimization, Constrained and unconstrained multivariable optimization, Direct substitution method, Lagrange's method of multipliers, KKT conditions, Quadratic Programming, Separable Programming, Convex Programming.

UNIT 2 (12 L): Linear Programming - Introduction and formulation of Linear Programming problems, Graphical solution method, Simplex Algorithm, Duality in linear programming. **Nonlinear Programming -** Sample Applications, Graphical Illustration of Nonlinear Programming Problems. **Integer Programming -** Prototype Example, Some IP Applications, Some Formulation examples, Some Perspectives on Solving Integer Programming Problems

UNIT 3 (7 L): Sequencing - Introduction, processing N jobs through two/three/M machines; **Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solution by linear programming.**

UNIT 4 (10 L): **Modern methods of Optimization – Metaheuristic techniques:** Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization etc. **Simulation -** Introduction & steps of simulation method, distribution functions and random number generation.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture:39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References:

1. A. Hamdy Taha Operations research: An introduction. Pearson Education India, 2017.

2. Hillier and Lieberman "Introduction to Operations Research", TMH
3. S. S. Rao. Engineering optimization: theory and practice. John Wiley & Sons, 2009.
4. J K Sharma, Operations Research Theory and Applications, MacMillan India Ltd.
5. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak

Course Outcomes (COs):

At the end of this course students will be able to

1. Apply basic concepts of mathematics to formulate an optimization problem
2. Cast engineering minima/maxima problems into optimization framework
3. Learn efficient computational procedures to solve optimization problems
4. Analyze and appreciate variety of performance measures for various optimization problems
5. Use tool to implement important optimization methods

Course Code: 19CP402T					**Course Name: Machine Learning**			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/ Wk**	**Theory**			**Total**
					Continuous Evaluation	**Mid Semester**	**End Semester**	**Marks**
4	0	0	4	4	25	25	50	100

Prerequisites: Linear Algebra, Probability, Calculus

Learning objectives:

- Understand the principles of Machine Learning algorithm.
- Work with machine learning algorithms for problems like regression, detection and classification.
- Learn tools to apply machine learning algorithms to real data and performance evaluation.

Unit wise allocation of course content

UNIT 1 (9 L) Fundamentals and Regression

Introduction, examples of machine learning applications, General Design perspectives and issues in Machine Learning, Supervised, Semi Supervised and unsupervised learning models, Linear Regression, Univariate and Multivariate cases, Logistic Regression, hypothesis formulation, decision boundary, cost function, gradient descent, regularization, bias variance dilemma, accuracy measures

UNIT 2 (8 L) Dimensionality reduction

Subset selection, Principal Component Analysis, Probabilistic PCA, case study using PCA, Factor analysis, Linear Discriminant Analysis, Comparison of PCA and LDA, Case study using LDA

UNIT 3 (10 L) Kernel machines

Optimal Hyperplane for linearly and non-separable patterns, soft margin hyperplane, cost function formulation, Kernel trick, vectorial kernels, multiple kernel learning, multiclass kernel machine

Unit 4 (10 L) Reinforcement Learning

Introduction, K-Armed Bandit, Elements of reinforcement learning, Model based learning, temporal difference learning, Generalisation

UNIT 5 (15 L) Deep Networks

Introduction, CNN Architecture, RNN architecture, Training, Loss functions, Problems of vanishing gradients, LSTM Activation functions, Batch Normalisation, Weight Initialisation, Learning rate decay, Long short term memory networks

Student centered learning: The element of project in the course will enable this pedagogy. Instructor will decide project in consultation with students at the beginning of the semester.

Lecture: 52Hrs
Tutorial: 00Hrs
Approximate Total: 52Hrs

Texts and References:

1.Ethem Alpaydin, Introduction to Machine Learning, Third edition, PHI, 2015
2.Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016
3.Shai Shalev-Shwartz, Shai Ben-David, Understanding Machine Learning from Theory to

Algorithms, Cambridge University Press, 2014.
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997
5. Simon Haykin, Neural Networks and Learning Machines, Third Edition, Paper Back, Pearson India, Low Price Edition
6. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.
7. Bishop, C. M. Pattern Recognition and Machine Learning. Springer. 2007.
8. Marsland, S. Machine Learning: An Algorithmic Perspective. CRC Press. 2009.
9. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.

Journals

- IEEE Transactions on Neural Networks, IEEE Transactions on Pattern Analysis and Machine Intelligence, Machine Learning, Journal of Machine Learning Research, IEEE Transactions on Knowledge and Data Engineering, ACM Special Interest Group on Knowledge Discovery and Data Mining Explorations Journal
- Conference Proceedings
- Neural Information Processing Systems (NIPS), Uncertainty in Artificial Intelligence (UAI), International Conference on Machine Learning (ICML), Computational Learning Theory (COLT), International Joint Conference on Artificial Intelligence (IJCAI)
- Data set repositories UCI Repository for machine learning is the most popular repository:
- http://www.ics.uci.edu/~mlearn/MLRepository.html
- Open source Software Weka 3: Data Mining Software in Java
- http://www.cs.waikato.ac.nz/ml/weka/

Course Outcomes (COs):

At the end of this course students will be able to

CO1: List machine learning algorithm for the problem domain.

CO2: Compare different machine learning algorithms for the problems.

CO3: Carryout machine learning technique to classification, pattern recognition, optimization and decision problems.

CO4: Analyze important parameters and structures of the machine learning algorithms.

CO5: Judge efficacy of machine learning algorithm.

CO6: Design and create machine learning algorithm.

Course Code: 19CP402P					Course Name: Machine Learning Lab		
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/ Wk	Practical		Total
					Continuous Evaluation	End Semester	Marks
0	0	2	1	2	25	25	50

Course Objectives:

- Understand datasets and its characteristics for implementing Machine Learning algorithm.
- Implement machine learning algorithms for problems like regression, detection and classification.
- Learn tools to apply machine learning algorithms to real data and performance evaluation.

Experiment Sessions using Programming would be based on following topics:

Linear Regression, Logistic Regression, ML techniques using Artificial Neural Networks, Back Propagation implementation, Naïve Bayes Network, ML techniques using Support Vector Machine, Dimensionality Reduction, Reinforcement learning, Bayesian network implementation, Inference from Bayesian Network.

The session may contain a mini-project within the course as decided by the tutor.

Course Outcomes: At the end of the course, students should be able to:

CO1: Identify the software tools for building Machine Learning algorithm.
CO2: Classify and build ML algorithms for classification, detection, regression etc.
CO3: Carryout implementation of ML algorithms using tools and dataset.
CO4: Analyse the outcome of ML algorithms and fine tune the performance.
CO5: Testing ML techniques in presence of incomplete and/or uncertain information.
CO6: Design ML algorithms for real world problems.

Course Code: 19CP403					Course Name: Internet of Things			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites:

- Fundamentals of Computing, Basics of Electronics, Basic knowledge of Digital Electronics and Microprocessors

Learning objectives:

- Explain the components of IoT Architecture and platforms of IoT ecosystem
- Identify difference between M2M and IoT with SDN and NFV
- Developing IoT Systems using Raspberry Pi and Python
- Apply analytics and transform data to draw meaningful conclusions from IoT Data

Unit wise allocation of course content

UNIT 1 (10 L): Introduction to IoT: IoT Basics, Physical and Logical Designs, Elements of IoT - Basic Architecture of an IoT Application Sensors & Actuators, Edge Networking (WSN), Gateway. Domain Specific IoTs - Home Automation, Smart Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Life Style.

UNIT 2 (13 L): M2M and IoT: Introduction, M2M, Difference between M2M and IoT, Software Defined Networking and Network Function Virtualization for IoT, **IoT Architecture -State of the Art** – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT 3 (8 L): Developing Internet of Things: IoT Systems – Logical Design using IoT, IoT Physical Devices and Endpoints, Programming Raspberry Pi with Python, Other IoT Devices, IoT Physical Servers and Cloud Offerings. Case Studies Illustrating IoT Design, Data Analytics for IoT, Internet of Things Privacy, Security and Governance. Data Aggregation for the IoT, Business Scope

UNIT 4 (8 L):

Introduction to Arduino platform and its programming using readymade libraries; Actuators: Study of selected actuators, their operating principles, applications, etc; Sensors: study of fundamental principles of sensors for various parameters, such as: temperature, humidity, pressure, gas, light, water-level (resistance), rotational/linear acceleration, solar radiation, color, GPS, etc. Their comparisons and use in IoT. Interfacing of camera, ethernet shield, xbee , wifi, bluetooth modules with the Arduino/Raspberry Pi platforms.

Project 1: Home Automation using IoT: To develop electronic system that controls electric appliances like fan, AC, window curtails, and Light using embedded system and IoT.

Project 2: Irrigation System Automation using IoT: To develop electronic system that controls applications like water level control, sprinkling of water, fertilizers, and pesticides using embedded

system and IoT.
Similar projects/topics could be: Smart dustbin, Intelligent Building, Smart harvesting, Smart Hospital, Smart classroom, Smart transportation/traffic, Smart museum, etc.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture:39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References:

1. "Internet of Things: A Hands - on approach" by Arsheep Bahga and Vijay Madisetti., Orient Blackswan Private Limited - New Delhi
2. Pethuru Raj and Anupama C. Raman. The Internet of Things: Enabling technologies, platforms, and use cases. Auerbach Publications,.
3. Internet of Things with Python, Gaston C. Hillar, Packt Open Source
4. Rajkumar Buyya and Amir Vahid Dastjerdi, eds. Internet of Things: Principles and paradigms. Elsevier.
5. Gastón C. Hillar. MQTT Essentials-A Lightweight IoT Protocol. Packt Publishing Ltd.
6. "The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black" by Donald Norris, McGraw-Hill Education TAB
7. “Motors for Makers”, by Matthew Scarpino, QUE
8. Make: Sensors" by Tero Karvinen, Shroff Publishers & Distributors Pvt Ltd
9. The internet of Things: Key Applications and Protocols" By Harsent, Boswarthick and Elloumi, Wiley
10. "Raspberry Pi User Guide" by Upton and Halfacree, John Wiley & Sons;
11. Recent publications for case studies.

Course Outcomes (COs):

At the end of this course students will be able to

1. Understand the components of IoT infrastructure.
2. Understand the architecture of IoT and its applications.
3. Analyze the development of Secure IoT system.
4. Analyzing data in IoT systems.
5. Create IoT environment using different sensor devices.
6. Development of IoT infrastructure for Industrial and Commercial Building Automation along with Real World Design Constraints.

Course Code: 19CP404P					**Course Name: Mini Project**			
Teaching Scheme					**Examination Scheme**			
					Review			**Total**
L	**T**	**P**	**C**	**Hrs/ Wk**	**Continuous Evaluation Review**	**Mid Semester Review**	**End Semester Review**	**Marks**
0	0	14	7	14	30	30	40	100

Prerequisites: All core courses

Learning objectives:

To provide an opportunity to the final year student to understand / design / develop / implement systems involving relevant aspects of engineering and its applications, involving individual effort by the student.

Scope:

The students of B.Tech. (CE) programs are expected to work on mini project in any of the CSE related areas. The different kinds of academic/Industrial projects that could be accepted as the student's mini project are conceived broadly as follows:

- Software Development
- System Design and Simulation
- Hardware Development / Implementation
- Embedded System (Software & Hardware combined) Development / Implementation
- Theoretical Modeling, Design and Analysis
- Technical Study including feasibility and comprehensive evaluation of technologies
- Technical Survey and Modeling
- Modules of a research and development project jointly guided by teams of faculty with a focus on synthesis of their class-room learning to solve real world problems

At the end of this course students will be able to do some of the following:

- Comprehensively investigate/study and development of software and/or algorithms in the related area.
- Development of Hardware / Embedded System/ ASIC (Circuits, HDL, FPGA, etc)
- Attempt to use the class-room learning to solve real world problems in the form of a team
- Design and apply different tools.

Lecture:0 Hrs
Tutorial: 0 Hrs
Approximate Total: 182 Hrs

Course Code: 19CP405					Course Name: Cloud Computing			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Learning objectives:

1. To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
2. To elaborate the frontier areas of Cloud Computing
3. To introduce programming and experiment with the various cloud computing environments
4. To shed light on the issues and challenges in Cloud Computing

Unit wise allocation of course content

UNIT I (8 L): Cloud Foundation and Overview: History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Introduction to Cloud Computing- Cloud issues and challenges, Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, and Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies

UNIT II (13 L): Virtualization: Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs, Pros and cons of virtualization, Virtualization Technology examples.
Resource Management and Load Balancing: Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning, Resource dynamic reconfiguration, Scheduling Techniques for Advance Reservation, Capacity Management to meet SLA Requirements, and Load Balancing, Various load balancing techniques.

UNIT III (12 L): Industrial Platforms and New Developments: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools. MapReduce and its extensions to Cloud Computing, HDFS, and GFS, Cloud Applications, Cloud Application Programming and the Aneka Platform.

UNIT IV (6 L): Advanced Topics in Cloud Computing: Energy efficiency in clouds, Market-based management of clouds, Federated clouds/InterCloud, Cloud Security - Cloud Access: authentication, authorization and accounting, Cloud Reliability and fault-tolerance - privacy, policy and compliance- Cloud federation, interoperability and standards.

Student centering learning: (The student centering learning contents should be declared at the

commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture:39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References:

1. Mastering Cloud computing, by Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, McGraw Hill
2. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "Distributed and cloud computing from Parallel Processing to the Internet of Things", Morgan Kaufmann, Elsevier – 2012
3. Cloud Computing: Principles and Paradigms, by Rajkumar Buyya, James Broberg,Andrzej M Goscinski, Wiley publication
4. Cloud Computing: A Practical Approach, by Toby Velte, Anthony Velte, McGraw-Hill Osborne Media
5. Essentials of Cloud Computing by K. Chandrasekaran
6. Recent publications for case studies

Course Outcomes (COs):

At the end of this course students will be able to

1. Understand the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications.
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud.
3. Classify different Virtualization techniques.
4. Comprehend different cloud platforms offered by industry.
5. Describe the issues related with cloud security, and Cloud SLA
6. Provide the appropriate cloud computing solutions and recommendations according to the applications used.

Course Code: 19CP406					Course Name: Advanced Operating System			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: Operating System, Computer Organization and Programming, Distributed systems.

Learning objectives:

- Operating system structuring
- Synchronization, communication and scheduling in parallel systems
- Distributed systems, their communication mechanisms, distributed objects and middleware
- Failures and recovery management
- System support for Internet-scale computing

Unit wise allocation of course content

UNIT I (06 L)

Introduction to Operating systems, Hardware resources, OS functionalities, Managing CPU and memory, Monolithic, Microkernel, spin structures,

UNIT II (10 L)

Virtualization: Introduction, Memory Virtualization, CPU and Device Virtualization. Shared Memory for Parallel systems: Synchronization, Communication, Lightweight RPC, Scheduling, Shared memory in Multiprocessor OS. Distributed OS: Lamport clock, Latency limits, Active network, Object based system, Java RMI.

UNIT III (11 L)

Global memory systems, Distributed shared memory systems, Distributed File System, System recovery and fault tolerance.

UNIT IV (12 L)

Map-Reduce and Content Delivery Network, Throughput and Latency, Security.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Students projects may include: • Distributed file systems • Data aware scheduling algorithms • Distributed operating systems • Distributed job management systems • Parallel programming languages • Distributed workflow systems • Distributed monitoring systems • Scientific computing with GPUs • Scientific computing with MapReduce • Distributed caching strategies • Distributed cache eviction policies • Distributed hash tables • Virtualization impact for data-intensive computing

Useful software for project may include: Operating systems: Linux, Windows • Scripting: BASH • Source control: SVN • Programming languages: Java, C/C++ • Job submission systems: GRAM, PBS,

Condor, Cobalt, SGE, Falkon • Programming models: MapReduce (Hadoop), MPI (MPICH), Multi-Threading (PThreads), Workflows (Swift, Pegasus/DAGMan, Nimrod, Taverna, BPEL) • File systems: FUSE Parallel file systems: GPFS, PVFS, Lustre • Distributed file systems: GPS, HDFS • Data services: GridFTP • Grid middleware: Globus • Cloud middleware: Nimbus, Eucalyptus, OpenNebula • Distributed hash tables: Chord, Tapestry • Simulation environments: GridSim, SimGrid, OptorSim, GangSim, Bricks • Virtualization: Sun Virtual Box, XEN, VMWare

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References

1. William Stallings, Operating Systems, Prentice Hall, 1995
2. Andrew S. Tanenbaum and Maarten van Steen. "Distributed Systems: Principles and Paradigms", Prentice Hall, 2nd Edition, 2007
3. Randy Chow and Theodore Johnson. "Distributed Operating Systems & Algorithms", Addison-Wesley, 1997.
4. Jean Bacon, Concurrent Systems, Addison – Wesley, 1998

Course Outcomes:

At the end of the course, the student will be able to:

1. Describe the issues in designing and implementing the distributed systems.
2. Understand inter-process communication, and distributed processing.
3. Implement the Parallel and Distributed file system.
4. Implement the concept of fault tolerance in Operating System.
5. Analyze the features of operating system
6. Simulate the concepts of Advanced Operating systems through application.

Course Code: 19IC403					Course Name: Image Processing			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: Mathematics, Digital Signal Processing

Learning objectives:

- To understand the relationship of mathematical transformation for image processing.
- To motivate for selecting appropriate solutions for a practical image processing approach.
- To facilitate the understanding of object recognition in image analysis.

Unit wise allocation of course content

UNIT I (10 L) Fundamentals and spatial domain processing

Introduction, Image sampling and quantization, basic relationships in pixels, basic intensity transformations, histogram processing, spatial filtering: smoothing and sharpening, basic mathematical tools in image processing, color models

UNIT II (09 L) Frequency domain processing

Sampling 2D functions, Aliasing, 2D Fourier Transform and properties, Filtering in frequency domain: smoothing, sharpening, selective filtering.

UNIT III (10 L) Image restoration and morphological operations

Model of image degradation process, restoration in presence of noise, estimating degradation function, Inverse filtering, MMSE filtering, Morphological operations: Erosion and dilation, opening and closing, basic morphological algorithms

UNIT IV (10 L) Image Segmentation and description

Point, line and edge detection, thresholding, basic segmentation algorithms: region based, watershed, image representation: chain codes, polygonal approximation, boundary and regional descriptors: textures, moments

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References:

1. Gonzalez, R. C., & Woods, R. E., “Digital image processing”, Pearson.
2. Sonka, Milan, “Image processing, analysis and machine vision”. Cengage Learning Pvt. Ltd.
3. Jayaraman, “Digital Image Processing”. McGrawhill.
4. Gose, Earl, “Pattern recognition and Image Analysis” PHI Learning Pvt. Ltd.
5. Alasdair, McAndrew, “A Computational Introduction to Digital Image Processing”. CRC Press.
6. Artyom M ,Grigoryan, “Image Processing”. Taylor & Francis Ltd.

7. Castleman, Kenneth “Digital Image Processing”. Pearson Education.

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand various mathematical transforms in image analysis.
2. Understand Color models and various applications of image processing.
3. Understand image data structures and image processing algorithms
4. Explain different Image enhancement techniques
5. Analyze the basic algorithms used for image processing &image compression with morphological image processing.
6. Design & Synthesize Color image processing and its real world applications.

Course Code: 19CP407					Course Name: Data Compression			
Teaching Scheme					Examination Scheme			
					Theory			Total
L	T	P	C	Hrs/ Wk	Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: None

Learning objectives:

- To provide students with contemporary knowledge in Data Compression and Coding.
- To equip students with skills to analyze and evaluate different Data Compression and Coding methods.

Unit wise allocation of course content

UNIT I (10 L)

Compression Techniques :Lossless Compression , Lossy Compression ,Measures of Performance
Mathematical Preliminaries for Lossless Compression Models: Physical Models, Probability Models, Markov Models, Composite Source Model, Coding: Uniquely Decodable Codes, Prefix Codes, Algorithmic Information Theory, Minimum Description Length Principle.
Huffman Coding: The Huffman coding Algorithm, Minimum Variance Huffman Codes, Adaptive Huffman Coding, Update Procedure, Encoding Procedure, Decoding Procedure, Golomb Codes, Rice Codes, Tunstall Codes, Applications of Huffman Coding, Lossless Image Compression, Text Compression, Audio Compression

UNIT II (09 L)

Arithmetic Coding, Introduction, Coding a Sequence, Generating a Tag, Deciphering the Tag, Generating a Binary Code, Uniqueness and Efficiency of the Arithmetic Code, Algorithm Implementation, Integer Implementation, Comparison of Huffman and Arithmetic Coding, Adaptive Arithmetic Coding
Dictionary Techniques : Static Dictionary, Digram Coding, Adaptive Dictionary, The LZ77 Approach, The LZ78 Approach, Applications : File Compression—UNIX compress, Image Compression—The Graphics Interchange Format (GIF), Image Compression—Portable Network Graphics (PNG), Compression over Modems—V.42 bis

UNIT III (10 L)

Predictive Coding: Prediction with Partial match (ppm), The basic algorithm, The ESCAPE SYMBOL, Length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Move-to-front coding, Lossless Image Compression CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markov Compression.
Mathematical Preliminaries for Lossy Coding: Distortion criteria, Models, The Quantization Problem, Uniform Quantizer, Adaptive Quantization, Forward Adaptive Quantization, Backward Adaptive Quantization, Nonuniform Quantization, pdf-Optimized Quantization, Companded Quantization

UNIT IV (10 L)

Vector Quantization: Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-

Gray Algorithm, Initializing the LBG Algorithm, The Empty Cell Problem, Use of LBG for Image Compression, Tree-Structured Vector Quantizers, Design of Tree-Structured Vector Quantizers, Pruned Tree-Structured Vector Quantizers, Structured Vector Quantizers, Pyramid Vector Quantization, Polar and Spherical Vector Quantizers, Lattice Vector Quantizers
Transform Coding: KLT, DCT, DFT, DWHT, Quantization and coding of Transformation coefficient, Application to Image compression: JPEG, Applications to audio compression.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Open Ended problems:
1. Design an architecture and algorithm for data compression in cache and main memory.
2. Design an algorithm for compressing photo or video that is shared across social media.
3. Design an algorithm for compressing data at sensor which is reporting temperature data.

Texts and References

1. Introduction to Data Compression, Khalid Sayood, Morgan Kaufmann Publishers
2. The Data Compression book, Mark Nelson, Jean Loup Gaily
3. Data Compression : The Complete Reference", David Saloman, Springer
4. An Introduction to Information Retrieval, Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, Cambridge University Press, Cambridge, England
5. Information storage and retrieval , Robert Korfhage, WILEY

Online reference: http://ocw.usu.edu/Electrical_and_Computer_Engineering/Information_Theory/

Course Outcomes:
At the end of the course, the student will be able to:

1. Explain the evolution and fundamental concepts of Data Compression and Coding techniques
2. Understand and select appropriate coding techniques for compression.
3. Differentiate between Lossy and Lossless compression.
4. Identify the basic software and hardware tools used for data compression.
5. Apply techniques for compression of binary programs, data, sound and image.
6. Analyze the operation of a range of commonly used Coding and Compression techniques.

Course Code: 19CP408					Course Name: Biometrics			
Teaching Scheme					Examination Scheme			
					Theory			Total
L	T	P	C	Hrs/Wk	Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Learning objectives:

- To provide an in-depth and comprehensive knowledge of the Bio-metrics.
- To expose the students to the frontier areas of Bio-metrics
- To motivate students to do programming and experiment with the various Bio-metrics environments
- To shed light on the issues and challenges in Bio-metrics

Unit wise allocation of course content

Unit I (09 L)
Introduction of Biometric traits and its aim, image processing basics, basic image operations, filtering, enhancement, sharpening, edge detection, smoothening, enhancement, thresholding, localization. Fourier Series, DFT, inverse of DFT.

Unit II (10 L)
Biometric system, identification and verification. FAR/FRR, system design issues. Positive/negative identification. Biometric system security, authentication protocols, matching score distribution, ROC curve, DET curve, FAR/FRR curve. Expected overall error, EER, biometric myths and misrepresentations.

Unit III (10 L)
Selection of suitable biometric. Biometric attributes, Zephyr charts, types of multi biometrics. Verification on multimodal system, normalization strategy, Fusion methods, Multimodal identification.

Unit IV (10 L)
Biometric system security, Biometric system vulnerabilities, circumvention, covert acquisition, quality control, template generation, interoperability, data storage. Recognition systems: Face, Signature, Fingerprint, Ear, Iris etc

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture:39Hrs
Tutorial: 0 Hrs
Approximate Total: 39Hrs

Texts and References:

1. Introduction to Biometrics, Anil Jain, Arun Ross, Nandkumar, Karthik, Springer

2. Guide to Biometrics, By: Ruud M.Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, Springer
3. Pattern Classification, By: Richard O. Duda, David G.Stork,Peter E. Hart, Wiley
4. Recent publications for case studies

Course Outcomes (COs):

At the end of this course students will be able to

1. Articulate the main concepts, key technologies, bio-metrics and the possible applications.
2. Apply biometric matching for identification
3. Identify algorithms for finger biometric technology
4. Apply facial biometrics for identification.
5. Apply iris biometric, voice biometric, physiological biometrics etc. for identification.
6. Design and develop applications using the the appropriate bio-metrics solutions.

Course Code: 19IC404					Course Name: Fundamentals of Remote Sensing			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: Computer Programming, Mathematics and Statistics.

Learning objectives:

- To understand remote sensing techniques.
- To Analyze earth surfaces from remote sensing data
- To interpret remotely sensed data
- To apply the remote sensing technique on given application

Unit wise allocation of course content

UNIT I (06 L)

Introduction – Sun and atmosphere, Concept of Signatures, Remote Sensing System, Indian Remote Sensing Programme; **Electromagnetic Radiation** – Velocity of EM Radiation, Polarization, Coherent Radiation, Propagation of EM waves from one medium to another, Attenuation, Sources of EM radiation for remote sensing; Reflection and Scattering mechanisms.

UNIT II (10 L)

Physical Basis of Signatures – Signature in the reflective OIR region, Microwave region;

UNIT III (12 L)

Remote Sensors – Classification of remote sensors, Selection of sensors, Spatial resolution, spectral resolution, temporal resolution; Introduction to Optical (Imaging mode, pushbroom cameras) and Microwave sensors (active and passive microwave sensors, side looking radar) , **Data Reception and Data Products** – Data formats, Ground segment organization, Data product generation, IRS data products;

UNIT IV (11 L)

Interpretation of remotely sensed data - Data Analysis, Visual Image analysis, Digital classification, Classification Accuracy

Applications of Remote Sensing for Earth Resources Management – agriculture, land cover/land use mapping. Application of deep learning techniques using open source tools in Remote sensing.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References

1. George Joseph – Fundamentals of Remote Sensing, Universities Press, 2005.
2. Reddy, M ANJI, Remote sensing and Geographical information systems, BS publications
3. John R. Jensen – Remote Sensing of the Environment, Pearson IN, 2016. ISBN 978-93-325-1894-0

Course Outcomes:

At the end of the course, the student will be able to:

1. Select the type of remote sensing technique / data for required purpose.
2. Identify the earth surface features from satellite images.
3. Analyze the energy interactions in the atmosphere and earth surface features.
4. Prepare thematic maps.
5. Apply the remote sensing technique on given application.
6. Understand current research issues in Remote Sensing.

Course Code: 19IC405					Course Name: Computer Vision			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: Linear Algebra, Probability

Learning objectives:

- Insight into image and video formation design, modelling and analysis.
- Ability to work with features above the pixel level.
- Develop ability to understand the difference in theory and practice of Computer Vision.

Unit wise allocation of course content

UNIT I (9 L)
Low level vision
Introduction, Pin hole camera, Intrinsic and extrinsic parameters of a camera, Geometric camera calibration, Color perception and representation, Color model and inference from color, Convolutions, Correlation filter as templates, Scale and image pyramid, Working with Image gradients and corners, SIFT and HOG features, Texture and Filters, Textons, Texture Synthesis and shape from texture

UNIT II (10 L)
Midlevel Vision
Segmentation by Clustering pixels, Segmentation by graphs Comparison of segmentation techniques, Hough Transform, Fitting lines and planes, Fitting using probabilistic models: EM algorithm, Motion Segmentation: Optical flow, Simple tracking strategies: Detection, matching, Particle filtering

UNIT 3 (10 L)
High Level Vision
Revision Learning to classify: Error, loss, classification strategies, classifying images: Features, Single subjects, Object detection: Face, detecting humans, State of the art in Object detection: Mask RCNN, Object Recognition, Hidden Markov Model, Fitting an HMM with EM, parsing people in image, structure model, Tracking people: Kinematic tracking

UNIT 4 (10 L)
Computer Vision using Deep Learning
Convolutional Neural Networks architectures, Convolution and Pooling, training CNN, Data Augmentation and Transfer Learning, Recurrent Neural Networks, LSTM, GRU, Applications like Image Captioning, Visual Question answering, soft attention

Student centered learning: The element of project in the course will enable this pedagogy. Instructor will decide project in consultation with students at the beginning of the semester.

Lecture: 39Hrs

Tutorial: 00Hrs
Approximate Total: 39Hrs

Texts and References:

Text

1. Forsyth and Ponce, Computer Vision: A Modern Approach, 2/e, Pearson Education
2. Simon Prince, Computer Vision: Models, Learning, and Interface, Cambridge University Press, 1/e
3. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer, 2010
4. Suetens, P. Fundamentals of Medical Imaging, Cambridge University Press
5. Prince, J. & Links, J. Medical Imaging Signals and Systems, Prentice Hall.
6. Deep Learning for Medical Image Analysis 1st Edition by S. Kevin Zhou (Editor), Hayit Greenspan (Editor), Dinggang Shen (Editor), Academic Press
7. Handbook of Medical Imaging: Processing and Analysis Management (Biomedical Engineering) 1st Edition, by Isaac Bankman, Academic Press
8. Koller and Friedman, Probabilistic Graphical Models: Principles and Techniques, MIT Press, 2009.
9. Yoo, Terry S. Insight into Images: Principles and Practice for Segmentation, Registration and Image Analysis, CRC Press,
10. Vision Science Photons to Phenomenology By Stephen E. Palmer, MIT Press
11. Vision A Computational Investigation into the Human Representation and Processing of Visual Information By David Marr, MIT Press

MOOC

https://www.udacity.com/course/introduction-to-computer-vision--ud810

http://crcv.ucf.edu/videos/lectures/2014.php

Other important CV pages

http://www-inst.eecs.berkeley.edu/~cs280/sp15/index.html

http://vision.stanford.edu/teaching/cs223b/syllabus.html

http://www.cs.ucf.edu/~bagci/teaching/computervision16.html

http://homepages.inf.ed.ac.uk/rbf/CVonline

Course Outcomes (COs):

At the end of this course students will be able to:

1. Understand the concept and component of Computer Vision.
2. Work with low level to high level vision.
3. Combine computer vision fundamentals with other domains like natural language processing.
4. Develop applications like classification, semantic segmentation, tracking, person identification.
5. Design and apply models based on deep neural networks.
6. Develop application using suitable tools of computer vision and deep learning.

Course Code: 19CP409					Course Name: Big Data Analytics			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: None

Learning objectives:

- To understand the issues of Big data.
- Learn Injecting data into Hadoop.
- Ability to build and maintain reliable, scalable, distributed systems with Hadoop.
- Able to apply Hadoop ecosystem components.
- Working with SPARK for Data Analysis.

Unit wise allocation of course content

UNIT I (10 L)

Introduction to big data:

Introduction, distributed file system, Big Data and its importance, Drivers, Big data analytics, Big data applications. Algorithms, Matrix-Vector, Multiplication by Map Reduce.

UNIT II (10 L)

Introduction to HADOOP:

Big Data, Apache Hadoop & Hadoop Ecosystem, MapReduce, Data Serialization.

UNIT III (9 L)

HADOOP Architecture:

Architecture, Storage, Task trackers, Hadoop Configuration

UNIT IV (10 L)

HADOOP ecosystem and yarn:

Hadoop ecosystem components, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley,

ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al. "Understanding Big data", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide", O Reilly 2012.
4. MapReduce Design Patterns (Building Effective Algorithms & Analytics for Hadoop) by Donald Miner & Adam Shook

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand the fundamental concepts of Big Data management and analytics
2. Learn distributed systems with Apache Hadoop.
3. Deploy Hadoop ecosystem components.
4. Understand Map Reduce paradigm and the Hadoop system and identify its applicability in real life problems.
5. Apply tools (SPARK) and techniques to analyze Big Data
6. Design a solution for a given problem using suitable Big Data Techniques

Course Code: 19CP4010					Course Name: Software Testing Methodologies			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: None

Learning objectives:

- To understand the software testing methodologies such as flow graphs and path testing, transaction flows testing, data flow testing, domain testing and logic base testing.

Unit wise allocation of course content

UNIT I (10 L)

Introduction

Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Flow graphs and Path testing:- Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT II (10 L)

Transaction Flow Testing:

Transaction flows, transaction flow testing techniques. Dataflow testing:- Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

UNIT III (9 L)

Domain Testing:

Domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT IV (10 L)

Paths, Path products and Regular expressions:

Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing:- overview, decision tables, path expressions, kv charts, specifications.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References

1. Software Testing techniques – Boris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr. K.V.K.K. Prasad, Dreamtech.

3. The craft of software testing – Brian Marick, Pearson Education.
4. Software Testing, 3rd edition, P.C. Jorgensen, Aurbach Publications (Dist.by SPD).
5. Software Testing, N.Chauhan, Oxford University Press.
6. Introduction to Software Testing, P. Ammann & J. Offutt, Cambridge Univ. Press.
7. Effective methods of Software Testing, Perry, John Wiley, 2nd Edition, 1999.
8. Software Testing Concepts and Tools, P.Nageswara Rao, dreamtech Press.
9. Software Testing, M.G.Limaye, TMH.
10. Software Testing, S.Desikan, G.Ramesh, Pearson.
11. Foundations of Software Testing, D.Graham & Others, Cengage Learning.
12. Foundations of Software Testing, A.P.Mathur, Pearson.

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand test processes and continuous quality improvement
2. Classify Types of errors and fault models
3. Identify methods of test generation from requirements
4. Generate test cases for variety of software
5. Assess the Test adequacy using control flow, data flow, and program mutations
6. Application of software testing techniques in commercial environments using various tools.

Course Code: 19IC406					**Course Name: Vehicular Networks**			
Teaching Scheme					**Examination Scheme**			
L	**T**	**P**	**C**	**Hrs/ Wk**	**Theory**			**Total**
					Continuous Evaluation	**Mid Semester**	**End Semester**	**Marks**
3	0	0	3	3	25	25	50	100

Prerequisites: basic knowledge of network protocols and wireless communication

Learning objectives:

- To understand the concepts of communication in vehicular environment
- To appreciate the design principles of protocols addressing high mobility of agents
- To design and implement the applications for vehicular environment

Unit wise allocation of course content

UNIT 1 (8 L):

Introduction, principles of vehicular communication, enabling technologies, cooperative system architecture, applications,

UNIT II (11 L):

vehicular communication standards: 802.11P MAC, DSRC and WAVE; channel capacity modeling and analysis; Vehicle mobility models: random, flow, trajectory analysis

UNIT III (10 L):

Routing protocols in VANET: location based routing, dealing with topology dynamics, information communication in VANET: local measurement, aggregation, dissemination

UNIT IV (10 L):

VANET Applications design: design of safety applications, real time communcation; infotainment applications; introduction to simulation framework: VsimRTI, integrating application, traffic and network simulators

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture:39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References:

1. VANET: Vehicular Applications and Inter-Networking Technologies, Hannes Hartenstein (Editor), Kenneth Laberteaux (Editor), Wiley publisher
2. Vehicular ad hoc Networks: Standards, Solutions, and Research; Editors: Campolo, Claudia, Molinaro**,** Antonella, Scopigno**,** Riccardo (Eds.) ; Springer publisher
3. Recent Research papers as communicated in class

Course Outcomes (COs):

At the end of this course students will be able to

1. Understand the concept of wireless communication in vehicular environment.
2. Understand the design principles of protocols and standards used in VANET.
3. Determine routing protocols in VANET.
4. Implement protocols for communication in vehicular environment.
5. Implement the safety and infotainment applications using VANET.
6. Simulate the VANET application.

Course Code: 19CP4011					Course Name: Cyber Security			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Learning objectives:

- To introduce the concepts of cyber-crime and cyber security.
- To understand the different cyber security vulnerabilities.
- Introduce the practice of Securing Web Application, Services and Servers.
- Understand the principles and practice of cyber law and cyber forensics.

Unit wise allocation of course content

UNIT I (10 L) :

Introduction to Cyber Crime

Introduction to cyber-crime, Data diddling, Data leakage, Eavesdropping, E-mail threats, Internet terrorism, Password cracking, Scavenging/Corporate Espionage, Social Engineering, Software Piracy, Spamming, Piggybacking, Trap door, Trojan Horse, Virus, Worm Impersonation, DOS Attack.

Introduction to Cyber Security

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

UNIT II (10 L):

Cyber Security Vulnerabilities

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness.

Cyber Security Safeguards

Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT III (09 L):

Securing Web Application, Services and Servers

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Email security, Social Media Security, Web Security, Mobile Security, Wi-Fi Security, Software Hacking, Reverse Engineering Cross site scripting & its Security.

UNIT IV (10 L):

Cyberspace Law

Introduction Computers and its Impact in Society. Introduction of Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN

Cyberspace, National Cyber Security Policy. Cyber Jurisprudence at International and Indian Level. Constitutional & Human Rights Issues in Cyberspace Freedom of Speech and Expression in Cyberspace. Right to Access Cyberspace – Access to Internet. Right to Privacy. Right to Data Protection.

Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References:

1. Chris Reed & John Angel, "Computer Law", Oxford University Press, New York.
2. Justice Yatindra Singh, "Cyber Laws", Universal Law Publishing Co, New Delhi
3. Sudhir Naib, "The Right to Information Act", 2005: A Handbook, Oxford University Press, New York,
4. Mayank Bhushan, Fundamentals of Cyber Security
5. Nina Godbole, Cyber Security, Wiley Publications
6. Nelson, Phillips, Enfinger, Steuart, "Computer Forensics and Investigations", Cengage Learning, India Edition, 2008.
7. Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003.
8. Anirudh Rastogi, "Cyber Law Law Of Information Technology And Internet",
9. Understanding Laws–Cyber Laws And Cyber Crimes(Lexix Nexis)
10. Cyber Crime Manual by Bibhas Chatterjee, Lawman Publication

Course Outcomes (COs):

At the end of this course students will be able to

1. Understand the importance of cyber security
2. Explain necessity of cyber laws
3. Apply the different cyber forensics technique
4. Compare various cyber security technique
5. Determine cyber security vulnerabilities
6. Create the mechanisms to be employed to secure web services.

Course Code: 19IC4010					Course Name: ICT for Energy Sector			
Teaching Scheme					Examination Scheme			
					Theory			Total
L	T	P	C	Hrs/Wk	Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: None

Learning objectives:

- To understand the concepts of smart grid and smart metering
- To understand the role of ICT in improving operations in energy sector
- To be able to design the energy efficient solutions for the real world problem

Unit wise allocation of course content

UNIT 1 (10 L)

Smart Energy Infrastructure, Smart Grids, Energy Consumption Profiling, Energy Data Management and Intelligent Load Control, Intelligent Scalable Monitoring and Control Technologies for Smart Micro-Grids and Grids. Software for energy applications; Data mining and decision support techniques for energy data; Models and techniques for energy consumption forecasting; Descriptions and characterizations of energy consumption patterns; Integration of energy data; Energy data visualization; Sensor networks, metering and energy data acquisition; Interoperability solutions including middleware and protocols for energy applications; Demand-side management; Home and building automation applications to energy; Energy-efficient control techniques; and Intelligent load control.

UNIT 2 (10 L)

Energy Management Systems in Industry: Demand control, Equipment scheduling, Temperature and humidity monitoring and control, Weather monitoring, Fan selection and speed control, Pump and valve monitoring and control, Refrigeration optimization, Boiler and turbine control, Safety and security, Smoke alarm monitoring, Sprinkler monitoring, Exhaust fan emergency control, Flood alarm, Perimeter door control, Elevator control, Building operations, Equipment maintenance scheduling, Maintenance cost accounting

UNIT 3 (10 L)

Green infrastructure-energy-efficient buildings, intelligent cooling systems, renewable power sources; green hardware - multicore computing systems, energy efficient server design and solid-state storage; and green software and applications - parallelizing computational science algorithms to run on modern energy efficient multi-core clusters, intelligent load distribution and CPU switch-off

UNIT 4 (9 L)

Smart Transportation Using ICT: Engine Management- The Need for More Precise Engine Management, Reliability, Electronic Ignition Systems, Fuel Injection and Carburetor Systems;

Transmission Control, Transport Planning: Depot Siting, Route Planning, Vehicle Scheduling, Scheduling of Road Transport Fleets, Scheduling of Other Transport Fleets; Urban Traffic Control; Route Guidance

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0Hrs
Approximate Total: 39 Hrs

Texts and References:

1. Smart Grid: Fundamentals of Design and Analysis, James A. Momoh, Wiley Publisher
2. Smart Grid: Technology and Applications, Akihiko Yokoyama, Janaka Ekanayake, Jianzhong Wu, Kithsiri Liyanage, and Nick Jenkins, Wiley Publisher
3. Intelligent Transportation Systems: Smart and Green Infrastructure Design; Sumit Ghosh and Tony S. Lee, CRC Press
4. Research papers discussed in class

Course Outcomes (COs):

At the end of this course students will be able to:

1. Understand the concept of smart grid and smart metering
2. Analyzing the applications for energy savings.
3. Understand the role of ICT in energy sector
4. Understand the concept of Smart transportation
5. Design and implement the energy efficient solutions for industry operations using ICT technologies
6. Design and implement smart transportation solutions using ICT technologies

Course Code: 19CP4012	Course Name: Human Computer Interaction

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Wk	Theory			Practical		Total
					MS	ES	IA	LW	LE/VIVA	Marks
3	0	0	3	3	25	50	25	0	0	100

Prerequisites: -

Learning Objectives:

- Learn the foundations of Human Computer Interaction
- Learn the guidelines for user interface
- Study the technologies for designing effective Human Computer Interfaces for individuals and persons with disabilities

Unit wise allocation of course content

UNIT I (10 L)

Introduction, Foundations of HCI: Human Vs. Computer, Goals and evolutions of HCI, I/O channels, Interaction: Models, frameworks, Ergonomics, styles, elements. Interactivity- Paradigms

UNIT II (9 L)

Models and Theories, Cognitive models, Socio-Organizational issues and stake holder requirements, Communication and collaboration models, Hypertext, Multimedia and WWW.

UNIT III (10 L)

Design Issues, Interactive Design basics: process, scenarios, navigation, screen design, Iteration and prototyping. HCI in software process: usability engineering, Prototyping in practice, design rationale.
Interaction Styles: Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages.
Design standards, guidelines, rules. Evaluation Techniques: Universal Design

UNIT IV (10 L)

Mobile and Web Interface Design, Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.
Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design and Tools.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0Hrs
Approximate Total: 39 Hrs

Text Book / Reference Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009
3. Ben Shneiderman, "Designing the User Interface-Strategies for Effective Human Computer Interaction", ISBN:9788131732557, Pearson Education , 2010
4. Brian Fling, "Mobile Design and Development", First Edition , O"Reilly Media Inc., 2009
5. Usability Engineering: Scenario-Based Development of Human-Computer Interaction, by Rosson, M. and Carroll, J. (2002)

Course Outcomes (COs):

At the end of this course students will be able to:

1. Understand the fundamentals of HCI and its relation to human computer interaction and other fields;
2. Understand the cognition and its importance for interaction design
3. Develop software prototype for interfaces with necessary interactive design standards and guidelines
4. Demonstrate usability testing of interactive design prototypes through examples
5. Design web and mobile interfaces with design concepts such as inlays, overlays and virtual concepts and various design tools.
6. Identify research issues in the field of HCI

Course Code: 19IC4011					Course Name: Statistical Pattern Recognition			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: Linear Algebra, Probability, Calculus

Learning objectives:

- Design and construction of pattern recognition system.
- Exposure to theoretical issues in design of pattern recognition systems.
- Understanding of major approaches in statistical pattern recognition.

Unit wise allocation of course content

UNIT 1 (10 L) Fundamentals and Feature Extraction

Introduction, Over view of Probability theory and Linear Algebra, Gaussian Distribution, Bayesian Decision Theory, Normalisation, Dimensionality Reduction, Feature Selection

UNIT 2 (10 L) Clustering and Non parametric density estimation

K-means, Hierarchical clustering, Fuzzy Clustering, Graph based clustering, Gaussian Mixture models, parametric estimation, Maximum Likelihood estimation, Maximum A Posteriori, Expectation Maximization, Sampling methods, Non parametric methods, Histograms, Parzen Window, Nearest neighbor

UNIT 3 (10 L) Classifiers and Ensemble

Linear Discriminants, Logistic Regression, Kernel Methods, Naïve Bayes, Nearest Neighbors, Boosting, Bagging, other combination techniques

UNIT 4 (15 L)Models

Model selection, over fitting, Bias-vs.-variance dilemma, Regularization, cross validation, Graphical models, Bayesian Networks, MRF, Inference in graphical models, Markov chains, HMM, PAC learning, VC dimensions

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39Hrs
Tutorial: 00Hrs
Approximate Total: 39Hrs

Text Book

1. Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.
2. Bishop, C. M. Pattern Recognition and Machine Learning. Springer. 2007.
3. Marsland, S. Machine Learning: An Algorithmic Perspective. CRC Press. 2009.
4. Theodoridis, S. and Koutroumbas, K. Pattern Recognition. Edition 4. Academic Press, 2008.
5. Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
6. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
7. Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.
8. Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press. 2009.

Papers

- Anil K. Jain, etc., "Statistical Pattern Recognition: A Review," IEEE Tran. on Pattern Analysis and Machine Intelligence, vol 22, No 1, Jan. 2000.
- A K Jain, etc., "Data clustering: A Review," ACM Computing Surveys, vol. 31, no. 3, Sept. 1999.

Important Links
http://kdd.ics.uci.edu/

Course Outcomes (COs):
At the end of this course students will be able to

1. Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms
2. Understand the basic methods of feature extraction, feature evaluation, and data mining
3. Implement a pattern classifier and ensemble recognition systems.
4. Understand and apply both supervised and unsupervised clasification methods to detect and characterize patterns in real-world data
5. Develop prototype pattern recognition algorithms that can be used to study algorithm behavior and performance against real-world multivariate data
6. Analyse related research in the pattern recognition.

Course Code: 19CP4013					Course Name: Information Retrieval System			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: None

Learning objectives:

- To provide an overview of Information Retrieval.
- To introduce students about insights of the several topics of Information retrieval such as – Boolean retrieval model, Vector space model.
- To provide comprehensive details about various Evaluation methods.
- To provide implementation insight about the topics covered in the course.
- To understand Crawling system
- To understand commercial application of web and retrieval system

Unit wise allocation of course content

UNIT I (10 L)

Introduction to Information retrieval

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, Information retrieval process, Indexing, Information retrieval model, Boolean retrieval model

UNIT II (09 L)

Dictionary and Postings

Tokenization, Stop words, Stemming, Inverted index, Skip pointers, Phrase queries Tolerant Retrieval Wild card queries, Permuterm index, Bigram index, Spelling correction, Edit distance, Jaccard coefficient, Soundex

UNIT III (10 L)

Evaluation Measure

Precision, Recall, F-measure, E-measure, Normalized recall, Evaluation problems

Latent Semantic Indexing

Eigen vectors, Singular value decomposition, Lowrank approximation, Problems with Lexical Semantics

UNIT IV (10 L)

Query Expansion

Relevance feedback, Rocchio algorithm, Probabilistic relevance feedback, Query Expansion and its types, Query drift.

Probabilistic Information Retrieval, Probabilistic relevance feedback, Probability ranking principle, Binary Independence Model, Bayesian network for text retrieval

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References

1. C. Manning, P. Raghavan, and H. Schutze, Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Ricardo Baeza -Yates and Breathier Ribeiro - Neto, Modern Information Retrieval: The Concepts and Technology behind Search 2nd Edition, ACM Press Books 2011.
3. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1st Edition Addison Wesley, 2009.
4. Mark Levene, An Introduction to Search Engines and Web Navigation, 2nd Edition Wiley, 2010.
5. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.
6. Ophir Frieder "Information Retrieval: Algorithms and Heuristics: The Information Retrieval Series", 2nd Edition, Springer, 2004.
7. Manu Konchady, "Building Search Applications: Lucene, Ling Pipe", and First Edition, Gate Mustru Publishing, 2008.

Course Outcomes:

At the end of the course, the student will be able to:

1. Understand different Information retrieval model.
2. Possess the ability to store and retrieve textual documents using appropriate models
3. Possess the ability to use the various retrieval utilities for improving search
4. Understand evaluation methods of the information retrieval model.
5. Possess an understanding of indexing and compressing documents to improve space and time efficiency
6. Understand issues in web search.

Course Code: 19CP4014					Course Name: Blockchain Technology			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites:- Information Security

Learning objectives:

- To understand the concepts of distributed consensus and trust management
- To understand the design principles of the block chains
- To design and implement the distributed ledger and the smart contracts

Unit wise allocation of course content

UNIT I (10 L)

Introduction to Blockchain, Building blocks: SHA 256, Peer to Peer Network, Distributed Ledger, Block mining, Proof of work, Miners and incentive mechanisms, Merkle tree, case-study applications of block chain framework: Bitcoin and transactions

UNIT II (08 L)

Consensus Algorithms: byzantine agreements, public and private block chain, hard and soft fork, side chains, 51% attack

UNIT III (11 L)

Ethereum Framework: Introduction, smart contract, Messages and transaction, state transition function, gas, applications, Solidity programming language: smart contract design, Rinke by testnet

UNIT IV (10 L)

Other frameworks: comparison with the liner block chains, Neo framework, proof of stake, IOTA Tangle, adding and verifying transactions, stability analysis, real-time operations on blockchain,

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture:39Hrs
Tutorial: 0 Hrs
Approximate Total: 39Hrs

Texts and References:

1. White papers of Bitcoin, Ethereum, IOTA and Neo frameworks and research papers as communicated in the class

Course Outcomes (COs):

At the end of this course students will be able to

1. Define the role of Blockchain technology in digitization.
2. Illustrate the cryptographic concepts, distributed concepts, and smart contracts related to Blockchain technology.
3. Experiment with Ethereum and Hyperledger framework for Blockchain development.
4. Analyze the need of Blockchain for real life system.
5. Choose the appropriate cryptographic primitives, type of Blockchain, mining method, and framework according to Blockchain usecase.
6. Create the smart contracts and Blockchain for suitable system.

Course Code: 19CP4015					Course Name: Green Computing			
Teaching Scheme					Examination Scheme			
L	T	P	C	Hrs/ Wk	Theory			Total
					Continuous Evaluation	Mid Semester	End Semester	Marks
3	0	0	3	3	25	25	50	100

Prerequisites: None

Learning objectives:

- To learn the fundamentals of Green Computing.
- To analyze the Green computing Grid Framework.
- To understand the issues related with Green compliance.
- To study and develop various case studies.

Unit wise allocation of course content

UNIT I (10 L)

Fundamentals

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

UNIT II (10 L)

Green Assets and Modeling:

Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

UNIT III (9 L)

Grid Framework:

Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.

UNIT IV (10 L)

Green Compliance:

Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.

Student centering learning: (The student centering learning contents should be declared at the commencement of semester. It should be maximum 10% ; however exact contents is left to faculty)

Lecture: 39 Hrs
Tutorial: 0 Hrs
Approximate Total: 39 Hrs

Texts and References

1. Bhuvan Unhelkar, ―Green IT Strategies and Applications-Using Environmental Intelligence, CRC Press, June 2014.
2. Woody Leonhard, Katherine Murray, ―Green Home computing for dummies, August 2012.
3. Alin Gales, Michael Schaefer, Mike Ebbers, ―Green Data Center: steps for the Journey, Shroff/IBM rebook, 2011.
4. John Lamb, ―The Greening of IT, Pearson Education, 2009.
5. Jason Harris, ―Green Computing and Green IT- Best Practices on regulations & industry, Lulu.com, 2008
6. Carl speshocky, ―Empowering Green Initiatives with IT, John Wiley & Sons, 2010.
7. Wu Chun Feng (editor), ―Green computing: Large Scale energy efficiency, CRC Press

Course Outcomes:

At the end of the course, the student will be able to:

1. Define Green IT with its different dimensions and Strategies.
2. Classify Green devices and hardware along with its green software methodologies
3. Apply the various green enterprise activities, functions and their role with IT.
4. Analyze the concepts of how to manage the green IT with necessary components
5. Select the various laws, standards and protocols for regulating green IT.
6. Discuss the various key sustainability and green IT trends.