M.TECH. COMPUTER SCIENCE (INTERNET TECHNOLOGIES)

DEPARTMENT OF COMPUTER SCIENCE

The Internet Technologies program is generally aimed at providing familiarity with various integral aspects of technology based learning. The approach involves theory part as well as practical sessions like a Flipped classroom. Sharing video before the class and conducting assessment like quizzes and hand-on session are the major activities drawn in like MOOC platform. Emphasizing the realistic understanding of the industrial based study is associated with the practical and hand-on sessions of each courses involved. The learner will have a thorough knowledge of the architecture as well as the applications of internet and the technologies behind. A simple chat system to social collaborative applications can be well designed and construct while acquired the technology behind the computing architecture and deployment models. By acquiring the mechanism of web service, socket programming, mobile apps , virtual simulations, serious games, cloud computing and collaborative applications like Facebook, twitter etc. the learner can built their own applications which can be utilized in industrial as well as educational purpose.

CURRICULUM

First Semester

Course Code	Type	Course	L T P	Cr
CS601	FC	Modern Computer Architecture	3 0 1	4
CS602	FC	Advanced Algorithms and Analysis	3 0 1	4
CS621	SC	Systems Security	3 0 0	3
CS603	FC	Mathematical Foundations of Computer Science	3 0 0	3
	E	Elective-I	3 0 0	3
HU601		Cultural Education*		P/F
				Credits 17

*Non-Credit Course

Second Semester

Course Code	Type	Course	L T P	Cr
CS622	SC	Parallel and Distributed Systems	3 0 1	4
IT621	SC	Internet Networks	3 0 1	4
CS624	SC	Enterprise Architecture	3 0 1	4
	E	Elective-II	3 0 0	3
	E	Elective-III	3 0 0	3
CS625	SC	Negotiated Studies	0 0 2	2
EN600	HU	Technical Writing*		P/F
				Credits 20

*Non-Credit Course

Third Semester

Course Code	Type	Course	L T P	Cr
	E	Elective –IV	3 0 0	3
	E	Elective –V	3 0 0	3
IT798	P	Dissertation		10
				Credits 16

Fourth Semester

Course Code	Type	Course	L T P	Cr
IT799	P	Dissertation		12
				Credits 12

Total Credits: 65

List of Courses

Foundation Core

Course Code	Course	L T P	Cr
CS601	Modern Computer Architecture	3 0 1	4
CS602	Advanced Algorithms and Analysis	3 0 1	4
CS603	Mathematical Foundations of Computer Science	3 0 0	3

Subject Core

Course Code	Course	L T P	Cr
CS621	Systems Security	3 0 0	3
CS622	Parallel and Distributed Systems	3 0 1	4
IT621	Internet Networks	3 0 1	4
CS624	Enterprise Architecture	3 0 1	4
CS625	Negotiated Studies	0 0 2	2

Electives

Course Code	Course	L T P	Cr
	Elective-I		
IT 701	Design of Internet Applications	3 0 0	3
IT 702	Mobile Networks	3 0 0	3
	Elective-II		
IT 703	Collaborative Applications on the Internet	3 0 0	3
IT 704	Semantic Web	3 0 0	3
	Elective-III		

IT 705	Image Recognition	3 0 0	3
IT706	Big Data Analytics	3 0 0	3
	Elective-IV		
IT707	Psychology of User Experience	3 0 0	3
IT708	Machine Learning	3 0 0	3
	Elective-V		
IT709	Technology Enhanced Learning	3 0 0	3
IT710	Content based Image and Video Retrieval	3 0 0	3

Project Work

Course Code	Course	L T P	Cr
IT798	Dissertation		10
IT799	Dissertation		12

CS601   **MODERN COMPUTER ARCHITECTURE**   **3-0-1- 4**

MIPS architecture – Basic concepts Instruction level parallelism – Concepts and challenges – Hardware and software approaches – Dynamic scheduling – Speculation - Compiler techniques for exposing ILP – Branch prediction. Multiple issue processors VLIW & EPIC – Advanced compiler support – Hardware support for exposing parallelism – Hardware versus software speculation mechanisms- Multiprocessors and thread level parallelism- Symmetric and distributed shared memory architectures – Performance issues – Synchronization – Models of memory consistency – Introduction to Multithreading. Memory and I/O- Cache performance – Reducing cache miss penalty and miss rate – Reducing hit time – Main memory and performance – Memory technology. Types of storage devices – Buses – RAID – Reliability, availability and dependability – I/O performance measures – Designing an I/O system. Multi-Core architectures- Tiled Multi-core Processors - On-Chip Networks for Mult-icore Systems- Speculatively Multithreaded Architectures- Throughput-Oriented Multi-core Processors- General-Purpose Multi-core Processors-GPU-GPU architecture-memory architecture-Thread modeling

TEXTBOOKS / REFERENCES:
1. John L Hennessy, David A Patterson, "Computer Architecture, A Quantitative Approach", Fourth Edition –-ELSEVIER, 2003.
2. Keckler, Stephen W., Olukotun, Kunle, Hofstee, H. Peter (Eds.), "Multi-core Processors and Systems", Springer, 2009.
3. David E. Culler, Jaswinder Pal Singh, "Parallel computing architecture: A hardware/software approach", Morgan Kaufmann /Elsevier , 2010.
4. Michel J Flynn, "Computer Architecture, Pipelined and Parallel processor Design", Narosa, 2010.

CS602   **ADVANCED ALGORITHMS AND ANALYSIS**   **3-0-1- 4**

Algorithm Analysis-Methodologies for Analyzing Algorithms, Asymptotic growth rates, Amortized Analysis. Divide and Conquer technique, Greedy techniques and Dynamic Programming, String Matching algorithms. Advanced Data Structures - Skip Lists, VAN Emde Boas Priority Queues, Fibonacci Heap. Universal hashing, SET data structure. Graphs - Data Structures for Graphs, Graph Traversal – Directed Graphs, Weighted Graphs, Single- Source Shortest Paths, All pairs Shortest Paths, Depth First Search, Breadth First Search and their applications, Minimum Spanning Trees, Network Flow and Matching, Flows and Cuts. NP-Completeness – P, NP, NP-hard, NP-completeness. Important NP-Complete Problems, Approximation algorithms. Randomized Algorithms: Las Vegas and Monte-Carlo, Markov Chains, Random Walks.

TEXT BOOKS / REFERENCES:
1. T.H. Cormen, C.E. Leiserson, R.L. Rivest, and S. Stein, "*Introduction to Algorithms*", Third Edition, MIT Press/McGraw Hill, 2001.
2. Michael T. Goodrich and Roberto Tamassia, *"Algorithm Design Foundations, Analysis, and Internet Examples*", John Wiley and Sons, 2003.

3. Rajeev Motwani and Prabhakar Raghavan, "*Randomized Algorithms*", Cambridge University Press, 1995.
4. Vijay V. Vazirani., Randomized Algorithms.

CS621   **SYSTEMS SECURITY**   **3-0-0-3**

Security Overview: Computer Security Concepts - Threats, Attacks, and Assets - Security Functional Requirements - security Architecture for Open Systems. Cryptographic Tools: Confidentiality with Symmetric Encryption - Message Authentication and Hash Functions - Public-Key Encryption - Digital Signatures and Key Management - Random and Pseudorandom Numbers - Practical Application: Encryption of Stored Data. User Authentication: Means of Authentication - Password-Based Authentication - Token-Based Authentication - Biometric Authentication - Remote User Authentication - Security Issues for User Authentication - Practical Application: An Iris Biometric System Access Control Principles - Example: UNIX File Access Control. Database Security: The Need for Database Security - Database Access Control - Statistical Databases - Database Encryption - Cloud Security Software Security - Software Security Issues - Handling Program Input - Writing Safe Program Code - Interacting with the Operating System and Other Programs - Handling Program Output. Operating System Security: Introduction to Operating System Security - System Security Planning - Operating Systems Hardening - Application Security -Security Maintenance - Linux/Unix Security - Windows Security - Virtualization Security. Trusted Computing and Multilevel Security: The Bell-LaPadula Model for Computer Security - Other Formal Models for Computer Security - The Concept of Trusted Systems - Application of Multilevel Security - Trusted Computing and the Trusted Platform Module . Legal and Ethical Aspects: Cybercrime and Computer Crime - Intellectual Property - Privacy - Ethical Issues.

TEXTBOOKS / REFERENCES:
1. W. Stallings, "Computer Security: Principles and Practice," 2st Edition, Prentice Hall, ISBN: 0132775069, 2011.
2. M. Stamp, "Information Security: Principles and Practice," 2st Edition, Wiley, ISBN: 0470626399, 2011.
3. M. E. Whitman and H. J. Mattord, "Principles of Information Security," 4st Edition, Course Technology, ISBN: 1111138214, 2011.
4. M. Bishop, "Computer Security: Art and Science," Addison Wesley, ISBN: 0-201-44099-7, 2002.
5. G. McGraw, "Software Security: Building Security In," Addison Wesley, ISBN: 0321356705, 2006.

CS 603   **MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE**   **3-0-0-3**

Logic: Propositional Calculus, Resolution in the propositional calculus, Predicate calculus, Resolution in the predicate calculus. Linear Algebra: Review of Matrices: Geometry of linear equations, Vector spaces and subspaces, linear independence, basis and dimensions, linear transformations, orthogonality, projections and least square applications. Probability and Advanced Statistics: Introduction to probability concepts, Bayesian approach to distributions, two dimensional random variables and joint probability distributions, stochastic independence of random variables, stochastic convergence and limit theorems, stopping rules for simulation experiments, multivariate

probability distributions, variance and covariance matrices, regression models using matrices. Theory of estimation, Bayesian methods of estimation, construction of test statistics, critical region, p value.

TEXTBOOKS / REFERENCES:
1. Gilbert Strang, "*Introduction to Linear Algebra*", Fourth Edition, Wellelsley- Cambridge Press, 2009.
2. Nils Nilsson, " Artificial Intelligence, A New synthesis" PHI
3. Douglas C. Montgomery and George C. Runger, "*Applied Statistics and Probability for Engineers*", Third Edition, John Wiley & Sons Inc., 2003.
4. Ronald E. Walpole, Raymond H Myres, Sharon.L.Myres and Kying Ye, "*Probability and Statistics for Engineers and Scientists*", Seventh Edition, Pearson Education, 2002.
5. A. Papoulis and Unnikrishna Pillai, "*Probability, Random Variables and Stochastic Processes*", Fourth Edition, McGraw Hill, 2002.

CS622   **PARALLEL AND DISTRIBUTED SYSTEMS**   **3-0-1-4**

Introduction: Basics of parallelization and parallelization strategies. Parallel/distributed programming models and interfaces - shared memory vs. message passing vs. remote procedure call (RPC) vs. global address space languages: e.g., pthreads, MPI, MapReduce, OpenMP, HPF, UPC, language-level threads (e.g., Java). Parallel machine architectures - shared and distributed memory machines, multicore and multithreaded chips, interconnection networks. Parallel program optimization techniques - synchronization granularity, dependences, scheduling, load balancing. Synchronization - hardware primitives, logical and physical clocks, mutual exclusion, distributed transactions, transactional memory. Consistency and coherence - data-centric versus client-centric consistency models, cache coherence protocols. Fault tolerance and reliability - fail-stop versus byzantine failure models, two- and three-phase commits, reliable group communication, check pointing, message logging.

Hadoop open-source framework - Spark.

TEXT BOOKS / REFERENCES:
1. Anantha Grama, George Karypis, Vipin Kumar, and Anshul Gupta Introduction to Parallel Computing, (Publishers: Addison-Wesley).
2. Ajay D. Kshemkalyani, Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2011.
3. Barry Wilkinson and Michael Allen , 'Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers', 2nd Edition, Prentice Hall, 2006.
4. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, "Distributed Systems: Concepts and Design"
5. Salim Hariri and Manish Parashar, "Tools and Environments for Parallel and Distributed Computing", Wiley-Interscience, 2004.

IT621   **INTERNET NETWORKS**   **3-0-1-4**

How internet works – TCP/IP, UDP - Throughput of network - bandwidth – measuring bandwidth - Computer networks and configuration - Setting up router- CDN and SDN - Unicast - multicast - IoT (partially) – Proxy servers – Virtual machines. P2P Systems.

Cloud Computing Overview - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service.

Cloud Computing Architecture - Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used.

Cloud Service Models - Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service(SaaS).

Cloud Deployment Models - Public cloud, Private cloud, Hybrid cloud, Community cloud. Cloud Security - Infrastructure Security, Data security and Storage.

Cloud Data Centers - Datacenter Components, Design Considerations, Power Calculations. Cloud Storage - Cloud Storage Concepts, Distributed File Systems, Cloud Databases

Case Study: Amazon Elastic Compute Cloud (EC2), Google Cloud Platform, Cloud Consulting Services.

Study of CloudSim:-System architecture simulation with CloudSim.

Open Source Tools - Red Hat's Cloud – OpenStack- OS independent- http://opensource.com/resources/what-is-openstack. - KVM (Kernel-based Virtual Machine);Deltacloud; Eucalyptus; Cloud.com; OpenNebula; Traffic Server; Cloudera; Puppet; Enomaly; Joyent; Zoho; Globus Nimbus; Reservoir

Hands-on: Create a cloud instance using Google cloud platform and connect it using web and mobile devices. https://cloud.google.com/

TEXTBOOKS / REFERENCES:
1. Andrew S. Tanenbaum, "Computer Networks", Fourth Edition, Pearson Education Asia, 2002.
2. Douglas E. Comer, "Internetworking with TCP/IP Volume – 1", Fifth Edition, Prentice Hall, 2008.
3. Behrouz A. Forouzan, "Data Communications and Networking", Fourth Edition, 2007.
4. Rajkumar Buyya and James Broberg "Cloud Computing: Principles and Paradigms", Wiley, 2013.
5. Rajkumar Buyya and Sabu M. Thampi "Intelligent Distributed Computing (Advances in Intelligent Systems and Computing)", Springer; 2015 edition, ISBN-13: 978-3319112268.

CS624   **ENTERPRISE ARCHITECTURES**   **3-0-1-4**

Enterprise architecture (EA) principles and purpose; modeling approaches for EA definition and communication; key enterprise architecture approaches, standards, and frameworks; best practice for development of enterprise architecture, analysis of alternative models for enterprise architectures; best practice approaches and models for documenting enterprise architectures; evaluation of alternative enterprise architecture approaches, identification and evaluation of gaps and opportunities in different enterprise architecture models and processes; models of different aspects of the enterprise architecture processes and artifacts, and architectures at different levels, including conceptual and technical.

Cloud Computing: The internet as a platform, Software as a service and cloud computing, cloud computing platforms, Cloud Technologies – Web Services – SOAP- AJAX, Virtualization and cloud, Mutitenant Software, Data in the cloud and cloud file systems. Big Data: Map Reduce, Hadoop

TEXT BOOKS / REFERENCES:
1. Scott A. Bernard., Authorhouse *"An Introduction to Enterprise Architecture "* 2nd Edition, 2005.
2. Gautam Shroff *"Enterprise Cloud Computing: Technology, Architecture, Applications"*, Cambridge University Press, 2010
3. Dan C Marinescu *, "Cloud Computing: Theory and Practice"* , Morgan Kaufmann, 2013
4. Sitaram and Manjunath , " Moving to the Cloud ", Elsevier, 2012.
5. Tom White , "Hadoop: The Definitive Guide", O'Reilly Media

CS625   **NEGOTIATED STUDIES**   **0-0-2-2**

Note: This course is intended to be a self study course. Each student can select an area of self study in consultation with the Faculty, collect and study basic and recent research articles (project reports, review articles, published articles in journals and book chapters.) on the topic. It can also involve semester long case study or mini projects involving programming, implementation, testing performance analysis etc. in different application specific contexts. Students will be required to make two in-class presentations and prepare a review article, possibly of publishable quality The Seminars and article will be evaluated for grading purpose. The evaluation will be done by a panel of (at least) two Faculty members.

EN600   **TECHNICAL WRITING**   **P/F**

Technical terms, Definitions - extended definitions; grammar checks: error detection, punctuation, spelling and number rules; tone and style; pre-writing techniques; online and offline library resources; citing references; plagiarism; graphical representation; documentation styles; instruction manuals; information brochures; research papers, proposals & reports (dissertation, project reports etc.), oral presentations.

TEXT BOOKS/REFERENCES:

1. Hirsch, Herbert L., Essential Communication Strategies for Scientists, Engineers and Technology Professionals, Second Edition, Wiley-IEEE Press, New York, 2000
2. Paul V. Anderson, Technical Communication: A Reader-Centred Approach, Sixth Edition. Cengage Learning India Pvt. Ltd., New Delhi, 2010.
3. William Jr., E.B. White, and Roger Angell, The Elements of Style, Fourth Edition, Longman, 1999.

IT701   **DESIGN OF INTERNET APPLICATIONS**   3-0-0-3

HTML5 - Basic html tags and its usage, what is new in HTML5, Media elements, Input types, Semantic elements, LocalStorage, SessionStorage, Cookies CSS3 - Different selectors. Different type of styling methods, JavaScript - Basic JavaScript functionalities and regular expressions. JQuery-How to download and use JQuery library. Server side programming - Introduction to server side programming and advantages of Node.js, Asynchronous and non-blocking IO, Node.js HTTP Server and TCP Server, NPM, How to create a simple HTTP server, Web framework with express, what is a framework and how to use a framework. Examples with Express module. Socket programming - Introduction to Socket programming, socket Emit, Broadcast and On methods, Node.js database communication, Create a basic mySql table and retrieve data from that using node.js mySql module. Ajax calls - Different Ajax call methods, Communicate with database using Ajax, JSON/XML formats, Share data in various formats. Advantages of JSON data format.

Introduction on android development, How to create a native android project, Managing Android SDKs, Remember/restore data while changing activity, Manage access permissions, Login; DB connectivity; Web service, Importing Libraries. Activity, UI components, Intent - Implicit and Explicit intent, Device debugging, Tutorial: Create a sample android app which includes implicit and explicit intents, Fetch Device details and Account details, Local storage (Shared preference, SQL Lite), Tutorial: Create an app which gets all the device and account details and stores these details in a SQL Lite table. Online storage, Connect to web services, Tutorial: Create an app which checks for validity of username and password with a remote database and stores the credentials in Shared preference. Notifications and toast, Menu, Handling phone buttons (Back, Options, Power), Broadcast receiver (Booting, Call, Net connection, Battery power), Sensors

Client server architecture, two tier, three tier, and n tier Architecture, Internet System Architecture – How an E-Mail Works, YouTube architecture, Video Streaming techniques, Implement a prototype of YouTube.

Hands-on: A web portal using HTML5 and CSS3. Sample mobile app with messaging functionality.

TEXTBOOKS / REFERENCES:
1. Randy J Hunt, "Product Design for the Web:, ISBN-13: 978-0-321-92903-7, New Riders,

2014.
2. Adrian McEwen , Hakim Cassimally "Designing the Internet of Things", Wiley, 8 November 2013.
3. Eric Hellman, Android Programming, Pushing the Limits, Wiley publishers.

IT702   **MOBILE NETWORKS**   **3-0-0-3**

Cellular Networks 1G and 2G: Cellular Frequency Reuse, Characterizing Frequency Reuse, Cellular Architecture, Advanced Mobile Phone System (AMPS), Cellular Digital Packet Data (CDPD), Wireless Generations, PCS, CdmaOne, GSM -Mobile Services, System Architecture, Protocols, Localization & Calling, Handover, Security. GPRS- GPRS System Architecture. EDGE. Beyond 3G Wireless Technologies: HSDPA - HSUPA - HSPA - LTE - Femtocells - 802.16m - LTE-Advanced 3G Technologies, Long Term Evolution (LTE) - LTE Goals - CDMA vs. OFDMA - MIMO -   Evolved Packet System (EPS) - Self-Organizing Network (SON) - IMT Advanced - IEEE 802.16m - LTE vs WiMAX vs WiMAX2 - LTE-Advanced Media Independent Handover: - IEEE 802.21: History and Timeline - Key Functions - Features - Goals and Non-Goals - Concepts - MIH Services - Network Initiated Handovers - MIHF Protocol - 802.21 Transport - 802.11 Amendments for MIH   Mobile IP: Mobile IPv4 – Features -   Terminology -   Processes - Encapsulation/Tunneling -   Home Networks with Dynamic IP Address - Dynamic Home Agent Assignment - Network Mobility (NEMO) - Security Issues - Mobile IP and VPN. Mobile IPv6 - Overview - Address Auto Configuration - Mobile IPv4 vs. IPv6 - Binding Updates - Route Optimization - Return Routability Procedure - Cryptographically Generated Addresses - Fast Handover - Hierarchical Mobile IPv6 (HMIPv6) - Proxy Mobile IPv6 TCP over Wireless: AIMD Principle - Slow Start Congestion Control - Fast Recovery - Problems of Current TCP - TCP Over Wireless - Link Layer Mechanisms - Split TCP Solutions - Indirect TCP - Snoop Protocol - Explicit Notification Schemes -   Explicit Loss Notification - TCP Over Satellite -   IETF TCPSAT - Our Results for Satellite Networks - Congestion Coherence - algorithms.

TEXTBOOKS / REFERENCES:
1. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2008.
2. Raj Kamal, "Mobile Computing", OXFORD UNIVERSITY PRESS.
3. Vijay.K.Garg, " Wireless Communications and Networking", Morgan Kaufmann 2010.
4. Wireless Communication Networks, William Stallings, PHI-2009.

IT703   **COLLABORATIVE APPLICATIONS ON THE INTERNET**   **3-0-0-3**

Pedagogy of collaborative mobile and web applications: Collaborative learning, Computer-supported collaborative learning, The objective and motivation of Social collaborative environment, Major collaborative applications, Psychology behind collaborative environment, Collaborative elements, Instructional designing strategies for collaborative applications, how to work autonomously within a collaborative environment. Assessments for collaborative experiences.

Collaborative Mobile and Web applications: A-VIEW, Blackboard. Google services, Google play store, Google map, Facebook.

Designing interactive and collaborative environments, Characteristics and classification of collaborative tools, Technological challenges to the research and development of collaborative environments. Identify the main types of services supporting online collaboration like: cloud computing, mobile technology. Identify the main types of tools supporting online collaboration like: common productivity applications, social media, online calendars, online meetings, online learning environments. Identify key characteristics of online collaborative tools like: multiple users, real time, global reach, concurrent access.
Mobile: Connect to the Internet securely using wireless mobile technology. Add, edit, remove a calendar event. Share pictures, videos using options like: e-mail, messaging, social media, Bluetooth. Understand the purpose of synchronizing content. Synchronize mobile devices with mail, calendar, other devices.

Pedagogy of Collaborative serious Game: Introduction to Serious Games and Virtual Simulations : Overview of games and simulations for learning, Rationale for game-based learning , Basic terms and concepts; definitions and game genres
Learning, Instruction, and Assessment with Games: Game attributes and learning outcomes, Models of game-based learning, Learning theories and games, Pedagogical approaches for learning with serious games, Principles for designing instructionally effective games, Assessment of learning with serious games
Collaborative Serious Games: Theoretical background on collaborative learning, Collaboration and serious games

Collaborative Serious Games- AI for games: Introduction to simulation- virtual simulations and serious games - basic terms/concepts- how computer simulations and games differ from analog simulations. Games for Learning and Game Based Learning: how do we design games that create rigorous learning of academic material.
HTML5 Gaming: Introduction to Canvas rendering, SVG and WebGL, Atlases, Map rendering, Basic Input, handling events, The entity hierarchy, Box2D, and using external libraries, Adding sound, Asynchronous Loading.

Hands-on: Create a collaborative whiteboard using node.js, use Imaginea-matisse (https://github.com/Imaginea/matisse) as open source code and make it collaborative. Create simple android collaboration application which will share message and files.

TEXTBOOKS/REFERENCES:
1. Katrin Becker and J. R. Parker Wiley, "The Guide to Computer Simulations and Games", Paperback, 480 pages. ISBN 9781118009239, December 2011.
2. James L Williams, "Learning HTML5 Game Programming", Addison-Wesley, 2012.
3. Patricia Comeaux, " Communication and Collaboration in the Online Classroom - Examples

and Applications", Anker Publishing Company, 2002

4. Casper Harteveld, Stephan Lukosch, and Rens Kortmann, "Improving Serious Game Design with Collaborative Storytelling", Proceedings of the 2nd International Workshop on Story-Telling and Educational Games (STEG'09), Aachen, Germany, August 21, 2009 (Online, vol. 498).

5. Torrente, J., Moreno-Ger, P., Martínez-Ortiz, I., & Fernandez-Manjon, B, "Integration and Deployment of Educational Games in e-Learning Environments: The Learning Object Model Meets Educational Gaming". Educational Technology & Society, 12 (4), 359–371, 2009.

IT704   **SEMANTIC WEB**   **3-0-0-3**

Introduction to Semantic web: Semantic Web Concepts –Need for the Semantic Web Information Overload- Stovepipe Systems- Poor Content Aggregation- XML and the Semantic web- Current Applications of the Semantic Web-XML and Web Services- XML Schema- XML Name Space- Document Object Model (DOM)- Use of Web Services- Basics of Web Services – SOAP-UDDI.
Understanding the Resource Description Framework (RDF): Capturing Knowledge with RDF-Other RDF Features – RDF Schema – Non Contextual Modeling, Using Relational Systems for RDF Storage.
Taxonomies: Overview of Taxonomies – Use of Taxonomies – Defining the ontology spectrum
– Thesaurus, Logical Theory – Ontology- Topic maps standards and Concepts - Occurrence – Association – Subject Descriptor – scope.
Ontologies: Overview of ontologies – Ontology Example – Definition – Syntax – Structure – Semantics – and Pragmatics – Expressing Ontologies Logically- Ontology and Semantic mapping problem.

TEXTBOOKS/REFERENCES:
1. Michael C.Daconta, Leo J. Obrst and Kevin T. Smith, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Fourth Edition, Wiley Publishing, 2003.
2. John Davies, Rudi Studer and Paul Warren John, "Semantic Web Technologies: Trends and Research in Ontology-based Systems", Wiley and Sons, 2006.
3. John Davies, Dieter Fensel and Frank Van Harmelen, "Towards the Semantic Web: Ontology-Driven Knowledge Management", John Wiley and Sons, 2003.

IT705   **IMAGE RECOGNITION**   **3-0-0-3**

Hands-on: Hand on session in Image deformation and geometric transformations, special noise filters. Hand on session in Erosion, Dilation, Opening, Closing and Hit-or-Miss Transform.

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry,

Perspective Projection, Spatial Domain Filtering, sampling and quantization.

Spatial Domain Filtering: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian. Filtering in the Frequency domain: Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Discrete Cosine Transform, Frequency domain filtering.

Image Restoration: Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

Image Compression: Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, FAX compression (CCITT Group-3 and Group-4),Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation.

Wavelet based Image Compression: Expansion of functions, Multi-resolution analysis, Scaling functions, MRA refinement equation, Wavelet series expansion, Discrete Wavelet Transform (DWT), Continuous Wavelet Transform, Fast Wavelet Transform, 2-D wavelet Transform, JPEG-2000 encoding, Digital Image Watermarking.

Morphological Image Processing: Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Geodesic Dilation, Erosion, Reconstruction by dilation and erosion.

Image Segmentation: Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, local processing, regional processing, Hough transform, Thresholding, Iterative Thresholding, Otsu's method, Moving averages, Multivariable Thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation.

TEXT BOOKS / REFERENCES:
1. John W Woods, "Multidimensional Signal, Image and Video Processing and Coding", Academic Press, 2006.
2. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2009.
3. William K. Pratt, "Digital Image Processing", Fourth Edition, Wiley Interscience, 2007.
4. Kenneth R. Castleman, "Digital Image Processing", Prentice Hall, 1996.
5. Gonzalez, Woods and Eddins, "Digital Image Processing Using MATLAB", Prentice Hall, 2004.

IT706   **BIG DATA ANALYTICS**   **3-0-0-3**

Introduction to Big Data Platform – Challenges of Conventional Systems – Intelligent data analysis – Nature of Data – Analytic Processes and Tools – Analysis vs. Reporting – Modern Data Analytic Tools – Statistical Concepts: Sampling Distributions – Re – Sampling – Statistical Inference – Prediction Error.

Introduction To Streams Concepts – Stream Data Model and Architecture – Stream Computing – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) Applications – Case Studies – Real Time Sentiment Analysis, Stock Market Predictions.

History of Hadoop – The Hadoop Distributed File System – Components of Hadoop – Analyzing the Data with Hadoop – Scaling Out – Hadoop Streaming – Design of HDFS – Java interfaces to HDFS – Basics – Developing a Map Reduce Application – How Map Reduce Works – Anatomyof a Map Reduce Job run – Failures – Job Scheduling – Shuffle and Sort – Task execution – Map Reduce Types and Formats – Map Reduce Features.

Setting up a Hadoop Cluster – Cluster specification – Cluster Setup and Installation – Hadoop Configuration – Security in Hadoop – Administering Hadoop – HDFS – Monitoring – Maintenance – Hadoop benchmarks – Hadoop in the cloud.

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – Hive QL – Querying Data in Hive – fundamentals of H Base and Zoo Keeper – IBM Info Sphere Big Insights and Streams. Visualizations – Visual data analysis techniques, interaction techniques; Systems and applications

TEXTBOOKS / REFERENCES:
1. Michael Berthold and David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis and Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
5. Jiawei Han and Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

IT707   PSYCHOLOGY OF USER EXPERIENCE   3-0-0-3

Introduction to prototyping approaches and strategies using Balsamiq and InvisionApp. Basics of layout and composition. New standards of design. Responsive User design.

Learning   Psychology: Information   Processing;   Cognitive   theories;   Constructivism: Social

constructivism; Cognitive Constructivism; Social Cognitive Theory; Distributed Cognition; Situated Learning; Theory of Multimedia Learning; Meta cognition, Self-Regulation; Theories of Motivation; Learner Self-Efficacy; Intelligence: Different approaches to intelligence; Modern theories of intelligence – Gardener's multiple intelligence, Sternberg's successful intelligence and PASS Model of intelligence; Creativity and its dimensions; Learner Diversity: Cognitive Styles; Learning Styles; Cross-cultural Issues in Education; Taxonomies in Education.

UI Design for Internet users : Interaction – interaction models, ergonomics, social and organization context. Basics of Design, design rules and principles; Representations using tools like OOP, OOM, UML etc.; HCI and Software process; HCI and implementation. Evaluation methods - usability, functionality, quantitative evaluations;

UX: User Stories, Sketching the User Experience, Graphical Environments, Telemetry plans, UX in the Cloud.

Hands-on: Prototype a sample application using Balsamiq and InvisionApp, that will be translated to responsive web page(s) utilizing HTML5,CSS-3 and Bootstrap.

TEXTBOOKS/REFERENCES:
1. Anita Woolfolk, "Educational Psychology" (Ninth Edition), Pearson Publications, 2004.
2. Robert A. Baron, "Psychology" (Fifth Edition), Prentice -Hall Pvt. Ltd., 2001.

IT708   **MACHINE LEARNING**   **3-0-0-3**

Introduction: Machine learning: Types of machine learning, Supervised learning, Unsupervised learning, Some basic concepts in machine learning, Review of probability, Computational Learning theory.
 Generative models for discrete data: Bayesian concept learning Likelihood, Posterior predictive distribution, The beta-binomial model , Naive Bayes classifiers , The log-sum-exp trick , Feature selection using mutual information, Classifying documents using bag of words, Gaussian models: Basics, Gaussian discriminant analysis, Inference in jointly Gaussian distributions, Linear Gaussian systems, Digression: The Wishart distribution, Inferring the parameters of an MVN, Baysian Statistics and Frequentist statistics, Linear Regression, Logistic regression.
 Directed graphical models (Bayes nets), Conditional independence, Inference, Learning Learning from complete data, Learning with missing and/or latent variables, Conditional independence properties of DGMs, d-separation and the Baye's Ball algorithm (global Markov properties), Influence (decision) diagrams, Mixture models and EM algorithm, Latent Linear models, Kernels, Adaptive basis function models, Clustering, Graphical model structure learning,

TEXTBOOKS / REFERENCES:

1. Kevin P. Murphey, " Machine Learning, a probabilistic perspective", The MIT Press Cambridge, Massachusetts, 2012,
2. Alex Smola and SVN. Viswanathan, "Introduction to Machine Learning:, Cambridge University Press, 2008.
3. E. Alpaydin, " Intrduction to Machine Learning", PHI, 2005.
4. Tom Mitchael, "Machine Learning", McGraw Hill, 1997.

IT709   **TECHNOLOGY ENHANCED LEARNING**   **3-0-0 3**

Learning: Different views of learning; Pedagogical principles and methodologies for effective teaching-learning; Internet based learning.
Internet Search Basics and other Topics: Internet search Overview – Google search – Search Engine.
Instructional Systems Design (ISD): Origin; ADDIE components of ISD; Models of ISD; Learning theories and ISD.
Different kinds of technology-supported learning: video-based instruction; games and simulations for learning; computer-supported collaborative learning, problem-based learning environments, open and distance learning, open education resources, tutored-video instruction, interactive video-conferencing; Use of technology in formal and informal contexts; Use of social networks for learning
Framework for Educational Technology: Issues Related to Technology; Pedagogy; Policy, Capacity Building, and Implementation; Technological Pedagogical Content Knowledge;
Current Programs and Projects in Technology-enhanced learning: National and Global;
Universal Design for Learning: Principles; Strategies for Diverse Student Needs; Emerging research areas in technology-enhanced learning.

Blended MOOC approach in Learning. Various learning activities; Alternatives to Pure E-Learning: Blended, Embedded, etc. Synchronous and Asynchronous Learning, Building Learning Architectures.

Knowledge Management, Digital Libraries and Repositories, Learning Content Management System, Courseware Development, Digital Libraries for Learning, Future Classrooms, Infrastructure of Education environments: basics of sound systems, mixers, mikes. Understanding Acoustics; Basics of Videography: lighting, and designing backgrounds; Setting up Networks and basic system administration; Teacher training for studio: movement, gestures, and camera awareness.

Web Based Learning; Interactive Whiteboard technologies (Blackboard, WebCT, etc.); Computer-Mediated Communication (CMC) Tools. Predictive analytics; automated intervention and adaptive analytics; Development of "intelligent curriculum" Personalization of learning based on intelligent curriculum.

Hands on Session: Web portal design and creation, Streaming Technologies: Red5, WebRTC. Social media integration using APIs: Facebook, Google and Wikipedia.

TEXTBOOKS / REFERENCES:

1. Ruth C. Clark and Richard E. Mayer, "e-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning", Pfeiffer, 2011.
2. Saul Carliner and Patti Shank, "The E-Learning Handbook: Past Promises, Present Challenges", Pfeiffer, 2008.
3. Clark N. Quinn, "Engaging Learning: Designing e-Learning Simulation Games", Pfeiffer, 2005.
4. William Horton, "E-Learning by Design", Pfeiffer, 2006.
5. Cindy Hmelo-Silver, Clark Chinn, Carol Chan and Angela O'Donnell, "The International Handbook of Collaborative Learning", Routledge, 2013.

IT710   CONTENT BASED IMAGE AND VIDEO RETRIEVAL   3-0-0-3

Architecture and Design: Introduction-Architecture of content-based image and video retrieval – Designing an image retrieval system- Designing a video retrieval system. Feature extraction and similarity measure: Color-Texture-Shape-Spatial relationships-MPEG 7features. Modeling and analysis of images: Classification and clustering – Annotation and semantic based retrieval of visual data – Probabilistic models – Relevance feedback. Analysis of video: Feature extraction-Semantics understanding- Summarization – Indexing and retrieval of video – mining large databases. Applications: Human facial database – Home object database – Online annotation systems – Medical image and video retrieval systems.

TEXTBOOKS/REFERENCES:
1. Oge Marques and Borko Furht, "Content Based Image and Video Retrieval", Multimedia Systems and Applications, Springer, 2002.
2. Oge Marques, "Practical Image and Video Processing", Wiley IEEE Press, 2011.
3. Borko Furht and Oge Marques, "Hand Book of Video Databases Design and Applications", CRC Press, 2003.