M. Tech Degree (Full Time) Programme

in

COMPUTER SCIENCE & ENGINEERING
(Specialisation: Network Computing)

SCHEME OF EXAMINATION & SYLLABUS

SCHOOL OF ENGINEERING
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN– 682 022

JULY – 2018

M. Tech Degree (Full Time) Programme in Computer Science & Engineering
(Specialisation: Network Computing)

SEMESTER I						
Sl No.	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	18-454-0101	Mathematical Foundations of Computer Science	3	1	0	4
2	18-454-0102	Parallel and Distributed Computing	3	1	0	4
3	18-454-01**	Elective I	3	1	0	3
4	18-454-01**	Elective II	3	1	0	3
5	18-454-0109	Network Programming and Simulation Lab	0	0	3	1
6	18-454-0110	Seminar I	0	0	3	1
7	18-454-0111	Research Methodology and IPR	2	1	0	2
Total			**14**	**5**	**6**	**18**

SEMESTER II						
Sl No.	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	T	P	
1	18-454-0201	Cluster and Grid Computing	3	1	0	4
2	18-454-0202	Cloud Computing	3	1	0	4
3	18-454-02**	Elective III	3	1	0	3
4	18-454-02**	Elective IV	3	1	0	3
5	18-454-0209	Parallel Computing Lab	0	0	3	1
6	18-454-0210	Seminar II	0	0	3	1
7	18-454-0211	Mini Project	0	0	3	2
Total			**12**	**4**	**9**	**18**

SEMESTER III						
Sl No.	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	T	P	
1	18-454-03**	Elective V	3	1	0	3
2	18-454-03**	Elective VI	3	1	0	3
3	18-454-0307	Dissertation Phase - I	0	0	20	12
Total			**6**	**2**	**20**	**18**

SEMESTER IV						
Sl No.	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	T	P	
1	18-454-0401	Dissertation Phase - II	0	0	30	18
Total			**0**	**0**	**30**	**18**

***Electives must be selected from the following list for the corresponding semester*

Total credits for the M.Tech. programme = **72**

ELECTIVES I & II (Semester I)

18-454-0103	Compiler for High Performance Computing
18-454-0104	Theory of Computation
18-454-0105	Advanced Data Mining
18-454-0106	Advanced Database Management System
18-454-0107	Wireless Sensor Networks
18-454-0108	Artificial Intelligence and Machine Learning

ELECTIVES III & IV (Semester II)

18-454-0203	GPU computing
18-454-0204	Soft Computing
18-454-0205	Big Data Analysis
18-454-0206	Natural Language Processing
18-454-0207	Operating System Design
18-454-0208	Cryptography and Network Security

ELECTIVES V & VI (Semester III)

18-454-0301	Sensor Network and Internet of Things
18-454-0302	High Performance Embedded Computing
18-454-0303	Deep Learning
18-454-0304	Data Forensics
18-454-0305	Multimedia Networking
18-454-0306	Data Visualisation

Syllabus For
M. Tech Degree (Full Time) Programme in Computer Science & Engineering
(Specialisation: Network Computing)

SEMESTER -I

18-454-0101 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Course Outcomes:
On completion of this course the student will be able to:

1. *Apply suitable reasoning techniques and proofs in problem solving.*
2. *Apply graph theory in computer science applications.*
3. *Design and analysis of algorithms in computational problems.*
4. *Apply various probability theories and design stochastic processes.*

Module I

Proofs – propositions – predicates and quantifiers – truth tables – first order logic – satisfiability – pattern of proof – proofs by cases – proof of an implication – proof by contradiction – proving iff – sets – proving set equations – Russell's paradox – well-ordering principle – induction – invariants – strong induction – structural induction – Pigeon hole principle – parity – number theory – divisibility – gcd – Euclid's algorithm – primes

Module II

Graph theory – simple graphs – isomorphism – subgraphs – weighted graphs – matching problems – stable marriage problem – graph coloring – paths and walks – shortest paths – connectivity – Eulerian and Hamiltonian tours – travelling salesman problem – trees – spanning trees – planar graphs – Euler's formula – directed graphs – strong connectivity – relations – binary relations – surjective and injective relations symmetry, transitivity, reflexivity, equivalence of relations – posets and dags – topological sort

Module III

Sums and asymptotics – arithmetic, geometric and power sums – approximating sums – harmonic sums – products – Stirling's approximation for finding factorial – asymptotic notations – recurrences – towers of Hanoi – solving recurrences – master theorem – linear recurrences – infinite sets – countable and uncountable sets – cantor's continuum hypothesis

Module IV

Probability – events and probability spaces – conditional probability – tree diagrams for computing probability – sum and product rules of probability – A posteriori probabilities – identities of conditional probability – independence – mutual independence – birthday paradox – random variables – indicator random variables – probability distribution functions – Bernoulli, Uniform, Binomial distributions – Expectation – linearity of expectations – sums of indicator random variables – expectation of products – variance and standard deviation of random variables – Markov's and Chebyshev's theorems – Bounds for the sums of random variables – random walks

References:

1. Eric Lehman, F Thomson Leighton, Albert R Meyer, Mathematics for Computer Science, MIT 2017.
2. R. P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5/e,Pearson Education India, 2006, ISBN : 978-8-17758-424-0.
3. J. A. Bondy and U. S. R. Murty, Graph Theory With Applications, Elsevier Science Publishing.ISBN:O-444-19451-7
4. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley,ISBN:978-0471333418
5. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis,Cambridge University Press ,ISBN:978-0521835404

18-454-0102 PARALLEL AND DISTRIBUTED COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Gain Knowledge about parallel processing and pipelining.*
2. *Distinguish multiprocessing and multicomputer systems*
3. *Design parallel and distributed algorithms.*
4. *Implement resource security and protection.*

Module I

Introduction to parallel processing - Overview of pipelining – pipelined data paths and control – Data hazards – Control hazards – Instruction level parallelism – Instruction level parallelism (ILP) – Reducing branch costs – exploiting ILP using static and dynamic scheduling – Data level parallelism.

Module II

Exploiting memory hierarchy – virtual machines – Cache coherence – Cache controllers – Parallelism and I/O. Shared memory Multiprocessors – Clusters and message passing processors – Hardware multithreading – SISD, MIMD, SIMD, SPMD and Vector – Computing GPUs.

Module III

Thread level parallelism – Centralised shared memory architectures – Distributed shared memory and directory based coherence – Synchronisation – Models of memory Consistency – multicore processors and their performance.

Module IV

Introduction to Distributed Algorithms, Kinds of Distributed Algorithms, Timing Models. Synchronous Network Algorithms: Synchronous Network Model, Leader Election in a synchronous Ring, Algorithms in a General Synchronous Networks, Distributed Consensus with Link Failures, Distributed Consensus with Process failures, More Consensus problems. Resource Security and Protection - Introduction – The Access Matrix Model – Implementation of Access Matrix Model – Safety in the Access Matrix Model – Advanced Models of protection – Data Security.

References:

1. David A Patterson and John L. Hennessy,Computer Organization and Design, The Hardware/ Software Interface, Fifth Edition, Morgan Kaufmann, 2013.
2. John L. Hennessy and David A Patterson,Computer Architecture-A Quantitative Approach, Sixth Edition, Morgan Kaufmann ,2017.
3. David B. Kirk and Wen-mei W. Hwu, Programming massively parallel processors: A hands-on approach, First Edition, Morgan Kaufmann, 2010.
4. Mukesh Singhal, Niranjan G. Shivaratri Advanced Concepts In Operating Systems: Distributed, Database, And Multiprocessor Operating Systems, Tata McGraw-Hill Edition, 2001.
5. George Coulouris, Jean Dollimore and Tim Kindberg, Distributed Systems Concepts and Design, Pearson Education, 5th Edition, 2011.

18-454-0103 COMPILER FOR HIGH PERFORMANCE COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Familiar with the structure of compiler for HPC.*
2. *Gain knowledge on Parallel loops, data dependency and exception handling and debugging in compiler.*
3. *Differentiate concurrency analysis and vector analysis.*
4. *Compare Message-Passing machines and Scalable Shared-Memory Machines.*

Module I

High Performance Systems:-Structure of a Compiler, Programming Language Features, Languages for High Performance. Data Dependence:- Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. Scalar Analysis with Factored Use-Def Chains:- Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains,Constant Propagation with FUD Chains, Data Dependence for Scalars. Data Dependence Analysis for Arrays.Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls,Inter-procedural Analysis.

Module II

Loop Restructuring:- Simple Transformations, Loop Fusion, Loop Fission,Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations. Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Module III

Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers. Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions, and Debuggers, Multi-vector Computers.

Module IV

Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout,Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics. Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines. Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

References:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson Education ,ISBN-10: 0805327304 .ISBN-13: 9780805327304
2. Polychronopoulos, Constantine D,Parallel Programming and Compilers,Springer US,ISBN:978-1-4612-8416-1

18-454-0104 THEORY OF COMPUTATION

Course Outcomes:

On completion of this course the student will be able to:

1. *Design finite automata to accept a set of strings of a language. Design new context free grammars*
2. *Minimize a Deterministic Finite Automata*
3. *Design a Turing machine to solve any problem whose algorithm is available.*
4. *Write the hierarchy of formal languages, grammars and machines.*
5. *Distinguish between computability and non-computability and Decidability and undecidability.*

Module I

Finite Automata: Finite state machines-state diagrams-DFA Minimization. Regular Languages, Properties, Pumping lemma. Context Free Languages: simplification- Normal Forms- CYK algorithm. Pumping Lemma for context free languages, Pushdown Automata.

Module II

Turing Machines: Language Acceptors- multitrack machines, Two-way Tape machines, multitape machines, nondeterministic Turing Machines. Turing Computable Functions: Sequential operation of functions, Composition of functions, Uncomputable functions.

Module III

Chomsky Hierarchy, Decision problems and recursive languages, Problem reduction, Church-Turing Thesis, Universal machines. Undecidability: Halting problem, Rice's Theorem, Post Correspondence problem. Primitive Recursive Functions, Godel Numbering, Computable partial functions.

Module IV

Computational Complexity: Measurement of complexity, Time complexity of Turing Machine, Linear Speedup, Properties of Time Complexity of Languages. Classes P and NP, Polynomial Time Reduction, Satisfiability problem, Class relations, NP complete problems, 3 Satisfiability Problem, Reductions and subproblems.

References:

1. Thomas A Sudkamp, Languages and Machines, Pearson Education , Third Edition, 2012. ISBN 978-81-317-1475-1.
2. J.E.Hopcroft,J.D.Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Education, 3 rd Edition, 2011. ISBN 978-81-317-2047-9.
3. Harry R. Lewis, Christos H Papadimitriou, Elements of the Theory of Computation, PHI Learning Pvt. Ltd. Second Edition 2010, ISBN 978-81-203-2233-2.
4. John Martin, Introduction to Language and Theory of Computation, TMH, 2007, ISBN 978-0-07-066048-9.

18-454-0105 ADVANCED DATA MINING

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the concepts of data mining phases and applications*
2. *Appreciate and evaluate various classification and association rule mining models.*
3. *Evaluate different types of clustering and its applications*
4. *Evaluate the concepts of times series, graph mining and social network analysis.*
5. *Familiarize the big data terminologies and technologies.*
6. *Conduct survey of various NoSQL data bases.*
7. *Familiarise various hadoop and spark components*

Module I

Data Mining-Purpose-Various phases of data mining - supervised vs. unsupervised –learning- Data Warehouses- OLAP-Multidimensional databases-Data Preprocessing-Different applications of data mining. Case studies in data pre-processing using R/WEKA/EXCEL/MATLAB

Module II

Association rules mining-Apriori algorithms- Examples -Possibilities for improvement-Classification and Prediction: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, neural networks, Support Vector Machines, Introduction to rough set concepts. Case studies in classification using R/WEKA/MATLAB/PYTHON

Module III

Cluster Analysis-K-Means algorithm-Example and suggestions for improvements- A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Time Series and Sequence Data: Mining Time-Series Data, Mining Sequence Patterns, Graph Mining. Case studies in clustering using R/WEKA/MATLAB/PYTHON

Module IV

NoSQL databases and the big data platform-A survey of various NoSQL data bases-Graph based, document based, column based-Neo4j, MongoDB, HBase, Oracle NoSQL database-Introduction to Map reduce concepts and Hadoop architecture- Neo4j and its application in Social Network data Analysis.Comparison of the big data frameworks: hadoop and spark. Case studies of big data applications:Recommendation systems, text mining applications.

References:

1. Jiawei Han and Micheline Kamber, Data Mining:Concepts and Techniques, 3rd edition Morgan Kaufmann Publishers, ISBN:978-93-80931-91-3.
2. G.K Gupta , Data mining, 1 st edition, PHI publications, ISBN:81-203-3053-6.
3. Sudheep Elayidom.M, Data mining and warehousing, Cengage learning, 2015, ISBN: 978-81-315-2586-9
4. K.P.Soman, Shyam Divakar, V. Ajay , Insight into data mining-theory and practice, 1st edition, PHI publications-ISBN: 978-81-203-2897-6.
5. Tom White, The hadoop definitive Guide, O Reilly Publications, 2015

18-454-0106 ADVANCED DATABASE MANAGEMENT SYSTEM

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain collection, storage and management of data.*
2. *Differentiate parallel and distributed databases.*
3. *Associate object oriented aspects of DBMS.*
4. *Apply DBMS principles to a distributed environment.*
5. *Explore mobile databases and the related techniques.*

Module I

Parallel And Distributed Databases: Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures - Parallel Databases: I/O Parallelism –Query and operation Parallelism –Distributed Databases - Three Tier Client Server Architecture- Case Studies.

Module II

Object And Object Relational Databases: Concepts for Object Databases: Object Identity and structure – – Encapsulation of Operations – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL – OQL – Object Relational and Extended – Relational Systems.

Module III

Enhanced Data Models: Temporal Databases – Spatial Databases –Multimedia Databases – Deductive Databases – XML Databases - Genome Data Management.

Module IV

Mobile Databases:Mobile Databases: Location and handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models.

References:

1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 7th Edition, Pearson, 2016.
2. Thomas Connolly , Carolyn Begg ,Database Systems: A Practical Approach to Design, Implementation, and Management ,6th Edition , Pearson. ISBN-13: 978-0132943260ISBN-10: 0132943263
3. Abraham Silberschatz , Henry F. Korth , S. Sudarshan Database System Concepts ,6th Edition ,ISBN-13: 978-0073523323 ISBN-10: 0073523321
4. C.J.Date, A.Kannan and S.Swamynathan,"An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
5. Vijay Kumar, Mobile Database Systems, John Wiley & Sons, 2006.
6. M. Tamer Ozsu , Patrick Valduriez, Principles of Distributed Database Systems 2011 , Third Edition, Springer.

18-454-0107 WIRELESS SENSOR NETWORKS

Course Outcomes:

On completion of this course the student will be able to:

1. *Explain common wireless sensor node architectures.*
2. *Carry out simple analysis and planning of WSNs.*
3. *Demonstrate knowledge of MAC protocols and routing protocols developed for WSN.*
4. *Understand mobile data-centric networking principles*

Module I

Mobile ad-hoc networking; imperatives, challenges and characteristics – Applications, Deployment & Configuration, Localization - Coverage and connectivity, Topology control, Connected dominating sets.

Module II

Wireless Communications- Link quality, shadowing and fading effects, Medium Access, - Scheduling sleep cycles, random access MAC, S MAC Energy efficient communication in adhoc networks. Power save protocols.

Module III

Data Gathering - Tree construction algorithms and analysis - Asymptotic capacity – Lifetime optimization formulations, Routing and Querying, Routing approaches. Proactive and reactive protocols. Clustering and hierarchical routing. Multipath routing. Security aware routing. Maximum life time routing.

Module IV

Collaborative Signal Processing and Distributed Computation:- Detection, estimation, classification problems Characterization of network traffic, QOS classification. Self similar processes. Statistical analysis of non - real time traffic and real - time services. Security issues- Attacks and countermeasures. Intrusion detection. Security considerations in adhoc sensor networks.

References:

1. Holger Karl & Andreas Willig,Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.
3. Kazem Sohraby, Daniel Minoii, & Taieb Znati, Wireless Sensor Networks- Technology, Protocols, And Applications, John Wiley, 2007.
4. Anna Hac. Wireless Sensor Network Designs, John Wiley, 2003.

18-454-0108 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the basics of Artificial intelligence and machine learning.*
2. *Familiarise the languages used for AI*
3. *Apply probabilistic approaches to learning*
4. *Apply the concepts of deep learning in problem solving*
5. *Apply the models for machine learning to solve problems*
6. *Develop new models for problem solving*

Module I

Machine Learning- Symbol based and Connectionist, Social and Emergent models of learning, Planning-Planning and acting in the real World, The Genetic Algorithm- Genetic Programming, Overview of Expert System Technology- Rule based Expert Systems, Introduction to Natural Language Processing. Implementation of Machine Learning algorithms. Languages and Programming Techniques for AI- Introduction to PROLOG and LISP, Search strategies and Logic Programming in LISP, Production System examples in PROLOG.

Module II

Unsupervised learning:Cluster analysis,-types of clustering methods, cluster evaluation, Advanced clustering methods. Inference in Probabilistic Models: Generative models for discrete data, Bayesian concept learning, Beta binomial, Dirchlet multinomial models, Naive Bayes classifiers, Gaussian Models.

Module III

Bayesian statistics: MAP estimation, Model selection, Hierarchical and Empirical Bayes, Bayesian decision theory, Bayes risk, Admissible estimators and properties, Empirical risk minimization.

Logistic regression: Model specification and fitting, Bayesian logistic regression, Fishers LDA, Generalized linear models. Graphical models: Examples of learning and inference, Mixture models and EM algorithm, latent linear models, PCA and ICA, Sparse linear models, Regularization and sparse coding, Kernels, SVM

Module IV

Adaptive basis function models, CART, Boosting, Multilayer perceptrons, Ensemble learning, Markov Random Fields and examples, Conditional Random Fields, Graphical model structure learning, Learning tree structures, Learning DAGs Dynamical Models: HMM and learning for HMMs, Deep Learning: Deep generative models, Boltzman models, Belief networks, Multilayer perceptrons, Applications of deep networks.

References:

1. George F Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education, 2002.
2. Winston. P. H, LISP, Addison Wesley, 1982.
3. Ivan Bratko, Prolog Programming for Artificial Intelligence, 3/e, Addison Wesley, 2000.
4. Kevin P Murphy, Machine learning: A probabilistic perspective, MIT Press, 2012.
5. The Elements of Statistical Learning: Data mining, Inference, and Prediction, Trevor Hastie et. al., 2nd Edn, Springer,(2009)

18-454-0109 NETWORK PROGRAMMING AND SIMULATION LAB

Course Outcomes:

On completion of this course the student will be able to:

1. *Write parallel programs using python tools.*
2. *Implement parallel algorithms.*
3. *Apply packet capturing and analysis methods.*
4. *Familiarise network simulation tools.*
5. *Do simulation and anlysis of network protocols.*

Experiments

1. Programming using Python Pexpect and Paramiko Libraries.
2. Programming with Python Scapy.
3. Programming with OpenFlow, OpenStack and OpenDaylight
4. Programming in python to test various network security algorithms.
5. Programming in python using pcap libraries.
6. Familiarise wireshark.
7. Simulation of various network protocols in different layers.
8. Simulation to study wireless and mobile communication protocols in various layers.
9. Simulation to study security and intrusion detection system systems in wired and wireless

References:

1. Eric Chou, Mastering Python Networking, Packt Publishing 2017.ISBN 978-1-78439-700-5.
2. W.R. Stevens, Unix Network Programming, Vol 1&II, 2nd ed., Prentice-Hall Inc., 1998.
3. Douglas E.Comer, Hands on Networking with Internet Technologies, 2nd edition,Addison-Wesley,2004. ISBN: 978-0-13148-696-6
4. ns3 users manual and tutorials.

18-454-0110 SEMINAR I

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify and familiarize with some of the good technical publications and journals in his/her field / topic of study.*
2. *Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references.*
3. *Understand effective use of tools for presentation, generate confidence in presenting a report before an audience and improve his/her skills in the same.*
4. *Develop skills like time management, leadership quality and rapport with audience.*

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the field of network computing. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 45 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

References:

1. David F. Griffiths,Desmond J. Higham Learning LaTeX, Society for Industrial and Applied Mathematics,2016. ISBN:978-1611974416
2. Lalit Mali, Libre office 5.1 Impress, Draw, Base book-Vol-2 ,Notion Press, 2017. ISBN:9781947027299.

18-454-0111 RESEARCH METHODOLOGY AND IPR

Course Outcomes:

On completion of this course the student will be able to:

1. *Demonstrate knowledge of research processes (reading, evaluating, and developing.*
2. *Perform literature reviews using print and online databases.*
3. *Summarize and discuss important issues and trends within the actual research area.*
4. *Write a scientific article within a limited topic but with a quality such that the article could be accepted for presentation in a conference or workshop.*
5. *Create a scientifically sound and reasonable and well documented plan for a Masters thesis project of excellent quality.*
6. *Understand the basics of the four primary forms of intellectual property rights.*
7. *Compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.*

Module I

Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches to investigation of solutions for research problem - data collection, analysis, interpretation. Necessary instrumentation.

Module II

Effective literature review approaches, Plagiarism, Research ethics.Effective technical writing. How to write a good report and a paper? Developing a Research Proposal, Format of research proposal, Presentation and assessment by a review committee.

Module III

Nature of Intellectual Property: Patents, Industrial Designs, Trademark and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grant of patents, Patenting under Patent Cooperation Treaty (PCT).

Module IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indication of goods. New Developments in IPR: Administration of Patent System. IPR of Biological Systems, Computer Software etc. Traditional knowledge: Indigenous, medicinal and bioprospecting knowledge, Need for protection. Case Studies.

References:

1. Stuart Melville and Wayne Goddard, Research methodology: an introduction for science & engineering students, Goddard Publisher, 1996.
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, 2 nd Edition ,Pearson, 2005.
3. Gopalakrishnan N S, and Agitha T G, Principles of Intellectual Property, 2nd Edition, Eastern Book Company, 2015.
4. Bansal K and Bansal P, Fundamentals of Intellectual Property for Engineers, BS Publications, 2013. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 4th Edition, Cengage Learning, 2012.
5. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 4th Edition, Cengage Learning, 2012.
6. Markel, Mike, Technical Communication. 11th Edition, Mac Millan, 2015.

SEMESTER -II

18-454-0201 CLUSTER AND GRID COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Design cluster architecture.*
2. *Differentiate resource management and scheduling in clusters and grids.*
3. *Compare cluster and grid technologies.*
4. *Interpret grid services and grid enabling software applications.*

Module I

An introduction to parallel systems- cluster architecture and single system image - parallel-programming paradigms - parallel programming with the message-passing interface (MPI) - resource management and scheduling in clusters.

Module II

An introduction to Grids and Grid technologies – Difference between cluster and Grid Technologies - programming models and parallelization techniques in grid.

Module III

Grid Service Architecture and Application - The Open Grid Services Architecture (OGSA) -Creating and Managing Grid Services - Web Services and Utility Computing, Grid-Enabling Software Applications.

Module IV

Grid security infrastructure - Data management - Resource management and scheduling in Grids - Grid economy - setting up a Grid, deploying Grid software and tools.

References:

1. Introduction to Parallel Computing, by Ananth Grama, ISBN:0201648652, Addison Wesley, 2003.
2. R. Buyya, High Performance Cluster Computing, Volume 1: Architectures and Systems, Prentice-Hall, 1999.
3. R. Buyya, . High Performance Cluster Computing, Volume 2: Programming andApplications, Prentice-Hall, 1999.
4. K. Dowd and C. Severance. High Performance Computing, 2nd ed. O'Reilly and Associates, 1998.
5. Joshy Joseph & Craig Fellenstein, Grid Computing, Pearson/PHI PTR-2003.

18-454-0202 CLOUD COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *State cloud computing fundamentals, cloud types and cloud applications.*
2. *Interpret cloud services and cloud service development environment.*
3. *Explain virtual data centre, information storage security and design.*
4. *Analyse various storage network designs.*
5. *Identify and explain cloud optimized storage*

Module I

Cloud Computing Fundamental: Cloud Computing definition- private, public and hybrid cloud. Cloud types: IaaS, PaaS, SaaS. Benefits and challenges of cloud computing - public vs private clouds - role of virtualization in enabling the cloud - Business Agility: Benefits and challenges to Cloud architecture - Application availability – performance -security and disaster recovery Cloud Applications: Technologies and the processes required when deploying web services- Deploying a web service from inside and outside a cloud architecture - advantages and disadvantages.

Module II

Cloud Services Management: Reliability, availability and security of services deployed from the cloud - Performance and scalability of services - tools and technologies used to manage cloud services deployment. Application Development: Service creation environments to develop cloud based applications - Development environments for service development.

Module III

Virtual Data Centre: Environments-concept-planning and design-business continuity and disaster recovery principle-. Managing VDC and cloud environments and infrastructures. Information Storage Security and Design : Storage strategy and governance - security and regulations – Designing secure solutions - the considerations and implementations involved - Securing storage in virtualized and cloud environments - Monitoring and management - security auditing and SIEM.

Module IV

Storage Network Design: Architecture of storage, analysis and planning - Storage network design considerations - NAS and FC SANs - hybrid storage networking technologies (iSCSI, FCIP, FcoE) - design for storage virtualization in cloud computin - host system design considerations. Cloud Optimized Storage: Global storage management locations – scalability – operational efficiency - Global storage distribution - terabytes to petabytes and greater -Policy based information management - metadata attitudes - file systems or object storage. Designing backup/recovery solutions to guarantee data availability in a virtualized environment.

Case study: Eucalyptus cloud.

References:

1. Gautam Shroff, Enterprise Cloud Computing: Technology, Architecture, Application, Cambridge University Press,2010. ISBN-13: 978-1-10766-854-6.
2. Nick Antonopoulos, Lee Gillame, Cloud Computing-rinciples, Systems and Application, Springer,2010. ISBN: 978-1-84996-241-4.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing, A Practical Approach, McGrawhill, 2009. ISBN: 978-0-07162-694-1.
4. Greg Schulz , Cloud and Virtual Data Storage Networking , Auerbach Publications, 2011. ISBN: 978-1-43985-173-9.
5. Volker Herminghaus, Albrecht Scriba, Storage Management in Data Centers, Springer, 2009. ISBN: 978-3-54085-022-9.

18-454-0203 GPU COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Apply concepts of parallel programming in problem solving*
2. *Write programs on GPUs.*
3. *Famliarise GPU synchronization.*
4. *Apply debugging and profiling parallel programs.*

Module I

Introduction: History, Graphics Processors, Graphics Processing Units, GPGPUs.Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC,Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps /Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D /3D thread mapping, Device properties, Simple Programs Memory: Memory hierarchy, DRAM / global, local / shared, private / local,textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

Module II

Synchronization: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU Functions: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

Module III

Support: Debugging GPU Programs. Profiling, Profile tools, Performance aspects Streams: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

Module IV

Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning Advanced topics: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-meiHwu;Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook;Morgan Kaufman; 2012 (ISBN: 978-0124159334)

18-454-0204 SOFT COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify and describe soft computing techniques and their roles in building intelligent machines.*
2. *Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.*
3. *Apply genetic algorithms to combinatorial optimization problems.*
4. *Evaluate and compare solutions by various soft computing approaches for a given problem.*
5. *Design artificial neural networks to solve various problems applicable in real life*

Module I

Introduction: Introduction to Soft Computing Concepts, Importance of tolerance in imprecision and uncertainty, Soft Computing Constituents and Conventional Artificial Intelligence, From Conventional AI to Computational Intelligence, Fuzzy Set Theory, Neural Networks and Evolutionary Computation Fuzzy Sets and Fuzzy Logic: Fuzzy sets versus Crisp sets, operations on fuzzy sets, Fuzzy Sets and Fuzzy Set Operations, Multicriteria Decision Making, Fuzzy Relations and Fuzzy Inference, Fuzzy Rule-based Systems.

Module II

Artificial Neural Network: The neuron as a simple computing element, the Perceptron, Multilayer Neural Networks, Supervised Learning Neural Networks, Unsupervised Learning Neural Networks, Radial Basis Function Networks, Reinforcement Learning, Self-Organizing Maps, Adaptive Resonance Theory, Associative Memories, Applications.

Module III

Evolutionary Computation: Genetic Algorithms and Genetic Programming, Evolutionary Programming, Evolutionary Strategies and Differential Evolution Coevolution, different operators of Genetic Algorithms, analysis of selection operations, convergence of Genetic Algorithms.

Module IV

Rough Sets: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications. Hybrid Systems: Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks, Genetic Algorithm for Neural Network Design and Learning, Fuzzy Logic and Genetic Algorithm for Optimization, Applications.

References:

1. Jyh-Shing Roger Jang., Chuen-Tsai Sun ,Eiji Mizutani, Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence, Prentice-Hall of India Pvt. Ltd., 2004. ISBN:978-0-13261-066-7.
2. K.H. Lee, First Course on Fuzzy Theory and Applications, Springer, 2005.
3. George J. Klir, Yuan Bo; Fuzzy Sets and Fuzzy Logic – Theory and Applications, Prentice-Hall of India Pvt. Ltd., 2001.
4. Simon Haykin, Neural Networks- A Comprehensive Foundation, Pearson Education, 2nd edition, 2001.
5. D. E. Goldberg,Genetic Algorithms in Search, Optimization & Machine Learning, Pearson Education , 2001.
6. S. Rajasekaran, G. A. Vijaylakshmi Pai, “Neural Networks, Fuzzy Logic, and Genetic Algorithms”, Prentice-Hall of India Pvt. Ltd., 2003.

18-454-0205 BIG DATA ANALYSIS

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the various common big data terminologies and applications*
2. *Appreciate and understand the cloud architecture and services*
3. *Analyse the configurations of various cloud deployment models.*
4. *Apply the eco system of HADOOP framework for big data applications.*
5. *Apply the SPARK framework components for big data applications.*

Module I

Data mining concepts, Applications of data mining, Stages of data mining-types of data mining applications-Data pre-processing-Principal component analysis- data normalization, data transformation- data reduction-Web mining-Types of web mining-Applications. CASE study: Data collection, cleaning, mining and testing using any data mining tool R/WEKA/PYTHON/MATLAB

Module II

Advanced data mining concepts-Basics of big data and cloud computing, Cloud computing Fundamentals, public vs. private clouds, Types of cloud services-PaaS, SaaS, IaaS, Examples for each service. Role of virtualization in enabling the cloud, Cloud Applications: Technologies and the processes required when deploying web services, Application Development: Service creation environments to develop cloud based applications. Development environments for service development: Amazon, Azure, Google App-Social network analysis-Tools and applications-Examples. CASE study: Understand the configuration of any cloud service like AWS/AZURE

Module III

Introduction to Big Data: Map-Reduce Basics: Functional Programming Roots, Mappers and Reducers, The Execution Framework, Partitioners and Combiners, The Distributed File System, Hadoop Cluster Architecture. MapReduce Algorithm Design: Local Aggregation, Combiners and In-Mapper Combining, Algorithmic Correctness with Local Aggregation, Pairs and Stripes, Computing Relative Frequencies, Secondary Sorting, Relational Joins. CASE studies using hadoop: Using mapreduce libraries for big data analysis

Module IV

Big Data and Hadoop : Introduction to Hadoop Distributed File System, Map-Reduce Implementation with Hadoop, Hadoop Data Types. BigData Management Tools: PIG: Pig's Data Model, HIVE: Hive Architecture, HIVEQL HBASE: MapReduce Integration, ZooKeeper, SQOOP.

SPARK: Architecture, components, RDD's, streaming data and its analysis CASE studies using SPARK: Using python libraries for big data analysis

References:

1. Jimmy Lin and Chris Dyer ,Data-Intensive Text Processing with MapReduce, Morgan & Claypool Synthesis Lectures, 2010, ISBN 978-16-08453-42-9.
2. Anthony T Velte, Toby J Velte, R. Elsenpeter, Cloud Computing a practical approach, Tata McGraw-HILL, 2010, ISBN 978-00-70683-51-8.
3. Jiawei Han & Micheline Kamber, Data Mining – Concepts and Techniques , Morgan Kaufmann Publishers, Elsevier, 2 nd Edition, 2006, ISBN:978-93-80931-91-3.
4. Ian.H.Witten, E.Frank,M.A Hall, Data mining-Practical machine learning tools and techniques, 3rd edition, Elsevier Publications, ISBN: 978-93-80501-86-4.
5. Margaret H. Dunham,S.Sridhar, Data Mining: Introductory and Advanced Topics, 1st edition, Pearson Education, ISBN: 978-81-77587-85-2.

18-454-0206 NATURAL LANGUAGE PROCESSING

Course Outcomes:

On completion of this course the student will be able to:

1. *Analyze issues in natural language processing tasks like machine translation, speech / language understanding etc.*
2. *Implement core algorithms (rule based and statistical) and data structures used in NLP*
3. *Development of new algorithms for NLP*
4. *Apply the NLP techniques to other applications like text processing, information retrieval etc.*
5. *Model computational grammar for languages and design new languages for communication.*

Module I

Words- Regular Expressions and Finite Automata-Morphology and Finite State Transducers-Probabilistic Models of Pronunciation and Spelling -N grams, HMMs and speech recognition, computational phonology and Text to speech

Module II

Syntax- Word Classes and Part-of-Speech Tagging and chunking-HMM Taggers- probabilistic Context Free Grammars for English Syntax-Parsing with Context Free Grammars- lexicalized and probabilistic parsing- Features and Unification-Language and Complexity

Module III

Semantics-Representing Meaning-canonical forms- FOPC-ambiguity resolution-scoping phenomen-Semantic Analysis-syntax driven semantic analysis-Lexical Semantics-Word Sense Disambiguation and Information Retrieval

Module IV

Pragmatics- Discourse-Reference Resolution -Text Coherence -Dialog and Conversational Agents-Dialogue acts-dialogue structure, natural language generation, Statistical alignment and machine translation-clustering- text categorization-word net

Case Study: Natural Language Processing using python

References:

1. Daniel Jurafsky and James Martin, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008
2. James Pustejovsky, Amber Stubbs, Natural language annotation for machine learning, O'Reilly, 2012
3. Alexander Clark and Chris Fox, The Handbook of Computational linguistics and natural language processing, Wiley-Blackwell, 2012
4. Grant S Ingersoll, Thomas Morton, Andrew L Farris, Taming Text, Manning Publications, 2013
5. Christopher D. Manning and Hin Rich Schutze, Foundations of statistical natural language processing, 1st Edition, MIT press, 1999

18-454-0207 OPERATING SYSTEM DESIGN

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the basic concepts of Operating Systems .*
2. *Identify the advantages and issues of distributed systems and database operating systems.*
3. *Identify the structure and architecture of multiprocessor operating systems.*
4. *Study the real time systems and their constraints.*
5. *Acquaint knowledge about mobile operating systems and application development*

Module I

Operating System Basics: Overview – Synchronization Mechanisms – Process and Threads- Process Scheduling – Deadlocks: Detection – Prevention- Recovery – Models of Resources – Memory Management.

Module II

Distributed Operating Systems: System Architectures- Design issues – Communication models – clock synchronization – mutual exclusion – election algorithms- Distributed Deadlock detection.

Database Operating Systems: Requirements of Database OS – Transaction process model – Synchronization primitives - Concurrency control algorithms.

Module III

Multiprocessor Operating Systems: System Architectures- Structures of OS – OS design issues – Process synchronization – Process Scheduling and Allocation- memory management.

Module IV

Real Time & Mobile Operating Systems: Basic Model of Real Time Systems – Characteristics- Applications of Real Time Systems – Real Time Task Scheduling - Handling Resource Sharing - Mobile Operating Systems –Microkernel Design - Client Server Resource Access – Processes and Threads - Memory Management - File system.

CASE STUDIES:

1. Linux System: Design Principles - Kernel Modules - Process Management Scheduling – Memory Management - Input-Output Management - File System – Interprocess Communication.
2. Windows System: Design Principles - System Components - Process and Thread Management - Memory Management - File System.
3. iphone iOS: Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.
4. Android OS : Architecture- Kernel- Libraries-run time -Application framework.

References:

1. Mukesh Singhal, Niranjan G. Shivaratri Advanced Concepts In Operating Systems: Distributed, Database, And Multiprocessor Operating Systems, Tata McGraw-Hill Edition, 2001.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Concepts, 10th Edition, John Wiley & Sons, 2018. ISBN: 978-1-118-06333-0.
3. Andrew S.Tanenbaum, Operating System DesignOperating System, Fourth Edition, Prentice Hall Inc., 2014.
4. Rajib Mall, Real-Time Systems: Theory and Practice, Pearson Education India, 2006.
5. Neil Smyth, iPhone iOS 6 Development Essentials – Xcode, eBookFrenzy, 2012. ISBN:978-0-98602-730-7.
6. Marko Gargenta, Learning Android, O'Reilly Media,2011 ISBN: 978-1-4493-905-0.

18-454-0208 CRYPTOGRAPHY AND NETWORK SECURITY

Course Outcomes:

On completion of this course the student will be able to:

1. *Analyse vulnerabilities in any computing system and design and propose a security solution.*
2. *Identify security issues in the network and provide data security over the network.*
3. *Impart knowledge on Encryption techniques, Digital signatures and message authentication code.*
4. *Understand various protocols for network security used to protect against threats in the networks.*
5. *Examine the issues and structure of Authentication Service and Electronic Mail Security.*

Module I

Attack on computers and computer security – Principles of security -Types of attacks – Cryptography - Concepts and Techniques – Symmetric key cryptography - Algorithms.

Module II

Asymmetric key algorithms – Digital Signatures – Message Digests – Message Authentication Code – Digital Certificates and Public key infrastructure.

Module III

Internet security Protocols – SSL- TLS – Secure Electronic Transaction – 3D secure protocols – Electronic money – E-mail security – WAP security.

Module IV

User Authentication – Authentication Tokens – Certificate based Authentication – Kerberos – Firewalls and Virtual private networks.

References:

1. William Stallings, Cryptography and Network Security Principles and Practice, 7th Edition, Pearson, 2017.
2. Behrouz A Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, McGraw Hill, 2015.
3. Atul Kahate, Cryptography and Network Security, 3rd Edition, McGraw Hill, 2013.

18-454-0209 PARALLEL COMPUTING LAB

Course Outcomes:

On completion of this course the student will be able to:

1. Set up homogeneous and heterogeneous cluster , grid and cloud computing platforms.
2. Implement parallel programming using message passing methods (PVM and MPI)
3. Acquaint python parallel computing tools**.**
4. Familiarise CUDA and OpenCL programming.
5. Familiarise big data processing tools.

Experiments

1. Setting up Linux based cluster,grid and cloud computing infrastructure for parallel computing.
2. Parallel programming to test various array manipulation algorithms using Messaging Passing libraries .
3. Parallel programming to test various search algorithms.
4. Programming with Python Asyncio.
5. Programming with python celery and SCOOP.
6. Programming with pyCUDA and pyOpenCL.
7. Familiarise Apache Hadoop and NoSQL for data processing.

References:

1. Giancarlo Zaccone, Python Parallel Programming Cookbook ,Packt Publishing Ltd,2015. ISBN 978-1-78528-958-3
2. David B. Kirk,Wen-mei W. Hwu, Programming Massively Parallel Processors-A Hands-on Approach,Morgan Kaufmann publications, ISBN: 978-0-12-381472-2

18-454-0210 SEMINAR II

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify and familiarize with some of the good technical publications and journals in his/her field / topic of study.*
2. *Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references.*
3. *Understand effective use of tools for presentation, generate confidence in presenting a report before an audience and improve his/her skills in the same.*
4. *Develop skills like time management, leadership quality and rapport with audience.*

Students shall individually prepare and submit a seminar report on a topic of current relevance related to the proposed project work. The reference shall include standard journals, conference proceedings, reputed magazines and textbooks and technical reports. The references shall be incorporated in the report following IEEE standards reflecting the state-of-the-art in the topic selected. Each student shall present a seminar for about 45 minutes duration on the selected topic. The report and presentation shall be evaluated by a team of internal experts comprising of 3 teachers based on style of presentation, technical content, adequacy of references, depth of knowledge and overall quality of the seminar report.

References:

1. David F. Griffiths,Desmond J. Higham,Learning LaTeX, Society for Industrial and Applied Mathematics,2016. ISBN:978-1611974416
2. Lalit Mali, Libre office 5.1 Impress, Draw, Base book-Vol-2 ,Notion Press, 2017. ISBN:9781947027299.

18-454-0211 MINI PROJECT

Course Outcomes:

On completion of this course the student will be able to:

1. *Conduct literature survey on network computing related topics.*
2. *Identify project topic of current field on computations.*
3. *Understand systematic method of doing a project.*
4. *Understand document and report preparation using Tex.*

Each student shall identify a project in the field of Parallel computing, Cloud computing, GPU computing, Massive Data Processing or Embedded computing etc. The project work has to be carried out within the department itself. A project guide will be allotted to each student by the head of the division / course coordinator. The project work shall be reviewed periodically and at the end of the semester each student need to submit a project report as per the format given by the project coordinator. The project must be evaluated by a team comprising of 3 internal examiners including the project guide, coordinator & a senior faculty member.

SEMESTER -III

18-454-0301 SENSOR NETWORK AND INTERNET OF THINGS

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify IoT Architecture and smart sensors.*
2. *Design IoT based sensor networks.*
3. *Design security mechanisms and middleware systems to be used in WSNs using IoT*
4. *Program IoT devices.*

Module I

Introduction and Applications:smart transportation, smart cities,living, smart energy, smart health, and smart learning. Examples of research include for instance: Self-Adaptive Systems, Cyber Physical System, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security

Module II

IoT Reference Architecture- Introduction, Functional View,Information View, Deployment and Operational View, Other Relevant architectural views.

Real-World Design Constraints- Introduction, Technical Design constraints-hardware, Data representation and visualization, Interaction and remote control.

Module III

Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary

Module IV

IOT Physical Devices & Endpoints: What is an IOT Device, Exemplary Device Board, Linux on Raspberry , Interface and Programming & IOT Device Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT

References:

1. Mandler, B., Barja, J., Mitre Campista, M.E., Cagá ová, D., Chaouchi, H., Zeadally, S.,Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing,ISBN: 9783319470634
2. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, David Boyle , “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, Academic Press, 2014, ISBN:9780080994017

18-454-0302 HIGH PERFORMANCE EMBEDDED COMPUTING

Course Outcomes:

On completion of this course the student will be able to:

1. *Design high performance embedded systems.*
2. *Apply various embedded processor architectures.*
3. *Evaluate different processor systems.*
4. *Analyze the performance of Hardware/Software co-design.*

Module I

Definition of embedded system - Constraints on embedded vs. standalone systems - Concept of real-time design - Time scales for real-time systems-Overview of computer architecture –ISA- Embedded Processor archetecture- Memory and I/O bus archtectures. The landscape of HPEC - Example applications - Design methodologies - Embedded Systems Design flows Models of computation -Parallelism and computation - Reliable system design – CE architectures.

Module II

Evaluating processors - RISC and DSP processors - Parallel execution mechanisms - Super scalar, SMID and Vector processors- Variable performance CPU architectures - CPU Simulation - Automated CPU Design. Code generation and back-end compilation - Memory oriented optimizations - Program performance analysis - Models of computation and languages.

Module III

Multiprocessor Architectures - Multiprocessor design techniques - Processing elements - Interconnection networks - Memory systems - Physically distributed systems and networks -multiprocessor design methodologies and algorithms.

Module IV

Multiprocessor software - RT multiprocessor operating systems - services and middleware for embedded multiprocessors - Hardware/Software co-design - performance analysis - Hardware/Software Co-Synthesis algorithms - Hardware/Software Co-Simulation.

References:

1. Marilyn Wolf, Computers as Components: Principles of Embedded Computer Systems Design, Morgan Kaufmann, 4th edition (September 2016) ISBN: 9780128053874 .
2. Marilyn Wolf, High-Performance Embedded Computing: Architectures, Applications, and Methodologies, Morgan Kaufmann,2nd edition (2014) ISBN: 9780124104884.
3. David R. Martinez (Editor), Robert A. Bond (Editor), M. Michael Vai (Editor), High Performance Embedded Computing Handbook: A Systems Perspective, CRC Press, (2008) ISBN-13: 978-0849371974
4. Noergaard, Embedded Systems Architecture: A 4.Comprehensive Guide for Engineers and Programmers,2nd edition, Elsevier (2012) ISBN-13: 978-9351070153

18-454-0303 DEEP LEARNING

Course Outcomes:

On completion of this course the student will be able to:

1. *Understand the mathematical aspects of machine learning.*
2. *Apply fundamental principles and frameworks of deep neural networks.*
3. *Design and analyse various deep learning algorithms and techniques.*
4. *Explore Deep learning techniques and various deep network architectures.*
5. *Design and develop an application using suitable tools.*

Module I

Review of Machine Learning- The math behind machine learning- Linear algebra, Statistics. Foundations of Neural networks and deep learning – Neural networks- Activation functions, Loss functions, Hyper parameters.

Module II

Fundamentals of Deep Networks – Definition, Common architectural principles, Building blocks.

Major architectures of deep networks- Unsupervised pre trained networks, Convolutional Neural Networks, Recurrent Neural networks, Recursive Neural networks.

Module III

Training Deep Neural nets – Reusing pre trained layers, faster optimisers, avoiding overfitting through regularisation. Distributing Tensorflow across devices and servers- Multiple devices on a single machine, multiple devices across multiple servers. Parallelising Neural networks on a Tensorflow cluster.

Module IV

Autoencoders- Stacked autoencoders, denoising autoencoders,sparse autoencoders, variational autoencoders.Reinforcement Learning – Temporal difference learning and Q-Learning. Vectorization – Introduction to vectorization in machine learning, Vectorising image data, Working with Text in vectorisation.

Case study: Deep learning using TensorFlow Library.

References:

1. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach 1st Edition,O'Reilly ISBN-13 : 978-1491914250,ISBN-10 : 1491914254
2. Ian Goodfellow,Yoshua Bengio,Aaeron Courvill Deep Learning ,The MIT Press, Cambridge, Massachusetts,London, England,2017
3. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 1st Edition, O'Reilly. ISBN-13:978-1491962299, ISBN-10:1491962291

18-454-0304 DATA FORENSICS

Course Outcomes:

On completion of this course the student will be able to:

1. *Apply different hacking techniques.*
2. *Interpret the software vulnerabilities that leads to hacking.*
3. *Understand different architecture strategies for computer fraud prevention and protection of websites.*
4. *Identify and compare different security attacks*
5. *Apply different methodologies for computer forensics.*

Module I

Hacking windows – Network hacking – Web hacking – Password hacking. A study on various attacks– Input validation attacks – SQL injection attacks – Buffer overflow attacks – Privacy attacks.

Module II

TCP / IP – IP Spoofing port scanning, DNS Spoofing. Dos attacks – SYN attacks, Smurf attacks, UDP flooding, DDOS – Models. Batch File Programming.

Module III

Computer Fraud – Threat concepts – Framework for understanding and predicting inside attacks -Managing the threat – Threat Strategic Planning Process. Architecture strategies for computer fraud prevention – Protection of Web sites – Intrusion detection system – Web Services security for Reducing transaction risks.

Module IV

Key Fraud Indicator selection process customized taxonomies – Key fraud signature selection process – Accounting Forensics – Computer Forensics – Journaling and it requirements –Standardized logging criteria – Journal risk and control matrix – Neural networks – Misuse detection and Novelty detection.

References:

1. Kenneth C.Brancik, Insider Computer Fraud, Auerbach Publications Taylor & Francis Group, 2008.
2. Ankit Fadia , Ethical Hacking, 2nd Edition Macmillan India Ltd, 2006.
3. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005.
4. Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, 2009.
5. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series:Computer Forensics), 2010.

18-454-0305 MULTIMEDIA NETWORKING

Course Outcomes:

On completion of this course the student will be able to:

1. *Identify multimedia data types like images, audio and video.*
2. *Apply image, video and audio compression algorithms*
3. *Demonstrate multimedia applications in network.*
4. *Analyse different devices and mechanisms for multimedia streaming*
5. *Compare different quality of service models and its mechanism for multimedia streaming*
6. *Demonstrate wireless multimedia communication.*

Module I

Introduction to Multimedia Networking, Paradigm shift of Digital Media Delivery, Telematics: Infotainment in automobiles, Major components of Multimedia Networking. Digital Speech Coding, Digital Speech Coding: LPC modeling and Vocoder, Regular Pulse Excitation with long-term prediction, Code-Excited Linear Prediction (CELP), Multiple-Pulse-Excitation Coding Digital Audio Coding: Human Psychoacoustics, Subband Signal Processing and Polyphase Filter implementation, MPEG-1 Audio Layers, Dolby AC3 Audio Codec, MPEG-2 Advanced Audio Coding (AAC), MPEG-4 AAC (HE-AAC).

Module II

Multimedia Applications in Networks. Introduction, Application Level Framing, Audio/Video Conferencing-Session Directories, Audio/Video Conferencing, Adaptive Applications, Reciever Hetrogenity, Real Time Application with Resource Reservation, Video Server, Applications requiring reliable multicast – White Board, Network Text Editor for Shared Text Editing, Multi Talk, Multicast file transfer, MultiMedia Applications on the World Wide Web – Multicast Web Page Sharing, Audio/Video Streams in the www, Interactive Multiplayer Games.

Module III

Digital Multimedia Broadcasting, Moving from DVB-T to DVB-H, T-DMB Multimediabroadcasting for portable devices.Multimedia Quality Of Service of IP networks,

Layered Internet Protocol (IP), IP Quality Of Service, QoS mechanisms, IP Multicast and Application-Level Multicast (ALM), Layered Multicast of Scalable Media.Quality Of Service issues in Streaming Architectures, QoS mechanisms for Multimedia Streaming, Windows Media streaming technology by Microsoft,SureStream Streaming Technology by RealNetworks, Internet Protocol TV (IPTV).

Module IV

Wireless Multimedia Communication: End to End QoS provisioning in Wireless Multimedia Networks – Adaptive Framework –MAC layer QoS enhancements in Wireless Networks – A Hybrid MAC protocol for Multimedia Traffic – Call Admission Control in Wireless Multimedia Networks – A Global QoS Management for Wireless Networks.

References:

1. Multimedia Communications: Protocols and Applications ,Franklin F Kuo, J.Joaquin Garcia , Wolf gang Effelsberg,Prentice Hall Publications.
2. Multimedia Communications : Applications, Networks, Protocols and Standards , Fred Halsall,Addison Wesley Publications.
3. Jean Warland and Pravin Vareya, High Performance Networks, Morgan Kauffman Publishers, 2002.
4. Nalin K Sharda, Multimedia Information Networking, Prentice Hall of India, 1999.
5. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, Multimedia Wireless Networks: Technologies, Standards and QoS, Prentice Hall, 2003.

18-454-0306 DATA VISUALISATION

Course Outcomes:

On completion of this course the student will be able to:

1. *Design and develop visualisation applications.*
2. *Classify Visualisation Systems.*
3. *Enumerate visualisation techniques for trees, graphs and networks.*
4. *Demonstrate visualisation of geographic information systems.*

Module I

Introduction of visual perception, visual representation of data, Gestalt principles, information overloads. Creating visual representations, visualisation reference model, visual mapping, visual analytics, Design of visualisation applications.

Module II

Classification of visualisation systems, Interaction and visualisation techniques misleading, Visualisation of one, two and multi-dimensional data, text and text documents.

Module III

Visualisation of groups, trees, graphs, clusters, networks, software, Metaphorical visualisation, Visualisation of volumetric data, vector fields, processes and simulations,

Module IV

Visualisation of maps, geographic information, GIS systems, collaborative visualisations, Evaluating visualisations. Recent trends in various perception techniques, various visualisation techniques, data structures used in data visualisation

References:

1. Matthew O. Ward, Georges Grinstein, Daniel Keim. Interactive Data Visualization: Foundations, Techniques, and Applications, Second Edition, A K Peters/CRC Press ,2015. ISBN:9781482257373
2. Edward Tufte, The Visual Display of Quantitative Information, Graphics Pres. ISBN:978-1930824133
3. Thomas Rahlf, Data Visualisation with R: 100 Examples,Springer, 2017.ISBN:9783319497518

18-454-0307 DISSERTATION PHASE-I

Course Outcomes:

On completion of this course the student will be able to:

1. *Conduct literature survey in the field of network computing and identify and concentrate on a research / industry related problem in the specified field.*
2. *Formulate a project proposal through extensive study of the literature and / or discussion with learned resource persons in academy, industry or around*
3. *Generate a proper execution plan of the project work to be carried out in Phase-II through deliberations.*
4. *Improve presentation skills.*

Each student shall identify a project in the field of network computing . The project work has to be carried out within the department itself. There is a project guide allotted to each student by the head of the division / course coordinator. The project work shall be reviewed and evaluated periodically by the project guide during third semester and be continued in the fourth semester. Under special cases, student can carry out a project in a reputed Industry / R&D institutions with the permission of course coordinator / HOD.

At the end of the semester, each student shall submit a project report comprising of the following.

1. Literature Review.
2. Application and feasibility of the project.
3. Objectives.
4. Detailed documentation including diagrams and algorithms .
5. Project implementation action plan.
6. References.

The project must be evaluated by a team comprising of 3 internal examiners including the project guide, coordinator & a senior faculty member.

18-454-0401 DISSERTATION PHASE-II

Course Outcomes:

O*n completion of this course the student will be able to:*

1. *Apply required theory and experiments on the problem related to industry / research identified in Phase-I and solve it.*
2. *Realize various steps involved in completing a project work like literature survey, methodology adopted (field study / survey / experiments / numerical work), analysis of the data to arrive at final results and conclusions.*
3. *Present and defend self-prepared report, verified by the project guide to a peer audience.*

The project work started in the third semester shall be reviewed and evaluated periodically in the fourth semester by the guide. At the end of the semester, each student shall submit a project report comprising of the following.

1. Literature Review
2. Objectives
3. Detailed documentation including diagrams and algorithms
4. Result / Output
5. Future scope
6. Conclusion
7. References

The thesis will be examined by an oral examination committee. The committee shall consist of the thesis supervisor (project guide), one faculty member from the department (course coordinator or faculty appointed by HOD) and one expert from outside the institute or within the department. The course coordinator will act as the Convener of the Committee. The final evaluation of the project shall include the following.

1. Presentation of the work
2. Oral examination
3. Demonstration of the project against objectives
4. Quality and content of the project report