Khulna University, Khulna
Science, Engineering and Technology School
Computer Science and Engineering Discipline

Master of Science in Computer Science and Engineering, abbreviated as M.Sc.Engg.(CSE)

Grand Summary

Type of M.Sc.Engg.(CSE)	**Taught Credits (Minimum)**	**Thesis/Project Credits**	**Total Credits (Minimum)**
Research Based	18.00	18.00	36.00
Coursework Based	30.00	6.00	36.00

Khulna University, Khulna
Science, Engineering and Technology School
Computer Science and Engineering Discipline
Summary of Courses for the Degree of M.Sc. Engg. (CSE)
(Effective from Academic Session: 2010-2011)

Course No.	Course Title	Specialized Areas	Credits
CSE 5000	Scientific Research Methodology	Compulsory	1.50
CSE 5001	Seminar		1.50
CSE 6000*	Master Thesis I: Research Proposal		6.00
CSE 6001*	Master Thesis II: Research		12.00
CSE 6002*	Master Project		6.00
CSE 5101	Advanced Algorithms	Theoretical Computer Science	3.00
CSE 5102	Combinatorial Optimization		3.00
CSE 5103	Graph Theory		3.00
CSE 5104	Computational Geometry		3.00
CSE 5105	Bioinformatics Algorithms		3.00
CSE 5106	Stringology		3.00
CSE 5107	Mathematical Programming		3.00
CSE 5108	Petri Net Theory and Modeling of Systems		3.00
CSE 5151	Cryptography		3.00
CSE 5201	Advanced Software Engineering	Software Engineering and Information Systems	3.00
CSE 5202	Software Project Management		3.00
CSE 5203	Software Testing and Quality Assurance		3.00
CSE 5204	Software Validation and Verification Tools		3.00
CSE 5251	Advanced Database Systems		3.00
CSE 5252	Information System Management		3.00
CSE 5301	Computer Communications and Networks	Communications and Computer Networks	3.00
CSE 5302	Wireless and Mobile Communication Networks		3.00
CSE 5303	Wireless Ad-hoc Networks		3.00
CSE 5304	Wireless Sensor Networks		3.00
CSE 5305	Wireless Resource Management		3.00
CSE 5306	Network Security		3.00

* A student will either do M.Sc. Thesis (CSE 6000 and CSE 6001) or M.Sc. Project (CSE 6002). A student cannot register course CSE 6001 without completing CSE 6000.

CSE 5401	Advanced Artificial Intelligence	Intelligent Systems	3.00
CSE 5402	Fuzzy Systems		3.00
CSE 5403	Machine Learning		3.00
CSE 5404	Advanced Pattern Recognition		3.00
CSE 5405	Speech Recognition		3.00
CSE 5406	Machine Translation		3.00
CSE 5407	Knowledge Representation and Reasoning		3.00
CSE 5408	Data Mining		3.00
CSE 5451	Evolutionary Algorithms		3.00
CSE 5452	Neural Networks		3.00
CSE 5501	Multimedia Systems	Multimedia Technology	3.00
CSE 5502	Computer Graphics and Animation		3.00
CSE 5503	Human Computer Interaction		3.00
CSE 5504	Multimedia Communication		3.00
CSE 5601	Parallel Algorithms	High Performance Computing	3.00
CSE 5602	Distributed Computing Systems		3.00
CSE 5603	Distributed Databases		3.00
CSE 5604	Ubiquitous Computing		3.00
CSE 5701	Advanced Microprocessors	Hardware Systems	3.00
CSE 5702	Advanced Logic Design		3.00
CSE 5703	Computer Organization and Design		3.00
CSE 5704	Advanced Computer Architecture		3.00
CSE 5705	Embedded Systems		3.00
CSE 5999	Special Topic on X**	Special Topic	3.00

** Here, ‘X’ will be a complete course name offered by the course teacher.

CSE 5000: Scientific Research Methodology
Credit Hour: 1.50
Prerequisite: None
Nature of the research process, types of research, ethics of research: voluntary participation, anonymity and confidentiality, deceiving subjects, analysis and reporting; research proposal, planning, purposes of research: exploration, description, explanation, 'hard-data' focus, 'soft-data' focus, conceptualization; some practical considerations: time, venue, instrument to be used etc, research team, interviewers, willingness of respondents to participate; data collection: four levels of evaluation, levels of data collection/unit of analysis; research methods and tools: interviews, group techniques, observation, questionnaires, company records/archive/information, self-generated measures; sampling; data analysis and interpretation: quantitative analysis, qualitative analysis; report writing: academic writing, technical writing; feedback sessions.

Computer Science Research Approaches. Theoretical vs. Empirical Methods in Computer Science. Theoretical Models in Computer Science. Theoretical Problems in Computer Science. Deductive Methods in Computer Science. Inductive Methods in Computer Science.

Recommended References

1. Research Methodology: A Step-by-Step Guide for Beginners, Ranjit Kumar, SAGE Publications Ltd, 3rd Edition, 2010.
2. Research Methods for Science, Michael P. Marder, Cambridge University Press, 1st Edition, 2011.
3. An Introduction to Scientific Research, E. Bright Wilson, Dover Publications; Rev Sub Edition, 1991.

CSE 5001: Seminar
Credit Hour: 1.50 (Three lecture sessions in a fortnight)
Prerequisite: None
Participants will work individually to prepare reviews of papers/topics assigned by course teacher and present before audience.

Theoretical Computer Science

CSE 5101: Advanced Algorithms
Credit Hour: 3.00
Prerequisite: None
Randomized Algorithms: Las Vegas and Monte Carlo Algorithms; Randomized Data Structures: Skip Lists; Amortized Analysis: Different methods, Applications in Fibonacci Heaps; Lower Bounds: Decision Trees, Information Theoretic Lower Bounds, Adversary Arguments; Approximation Algorithms: Approximation Schemes, Hardness of Approximation; Fixed Parameter Tractability: Parameterized Complexity, Techniques of designing Fixed Parameter Algorithms, Examples; Online Algorithms: Competitive Analysis, Online Paging Problem, k-server Problem; External Memory Algorithms; Advanced Data Structures: Linear and Non-linear Methods

Recommended References
1. Introduction to Algorithms - Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, MIT Press, 3rd Edition, 2009.
2. The Design of Approximation Algorithms, David P. Williamson, David B. Shmoys, Cambridge University Press, 2011.
3. Online Computation and Competitive Analysis, Allan Borodin and Ran El-Yaniv, 2005.
4. Approximation Algorithms, V. Vazirani, Springer-Verlag, 2004.
5. Computer Algorithms- Introduction to Design & Analysis, Sara Baase, Allen Van Gelder, Addison-Wesley, 3rd Edition, 1999.

CSE 5102: Combinatorial Optimization
Credit Hour: 3.00
Prerequisite: None
Introduction to Optimization; Linear Programming: Different forms, Simplex Method, Primal-Dual theory; Max-Flow: The Max-Flow-Min-Cut Theorem, Ford-Fulkerson Labeling Algorithm, Dijkstra's Algorithm, The Floyd-Warshall Algorithm; Some Network Flow Algorithms: The Minimum Cost Network Flow Method, Transportation Problem; Capacitated Transportation Problem, Assignment Problem; Integer Linear Programming; Relaxation; Cutting-Plane Algorithm; Branch and Bound Technique; Dynamic Programming; NP-Completeness; TSP and Heuristics; Approximation.

Recommended References
1. The Design of Approximation Algorithms, David P. Williamson, David B. Shmoys, Cambridge University Press, 2011.
2. Combinatorial Optimization Algorithms and Complexity, C.H. Papadimitrion, Dover Publications, Unabridged Edition, 1998.
3. Discrete and Combinatorial Mathematics, Ralph P. Grimaldi, Pearson Education, 5th Edition, 2003.
4. Combinatorial Optimization: Theory and Algorithms, By Bernhard Korte, Jens Vygen, Springer, 4th Edition, 2007.

CSE 5103: Graph Theory
Credit Hour: 3.00
Prerequisite: None

Introduction, Fundamental concepts, Trees, Spanning trees in graphs, Distance in graphs, Eulerian graphs, Digraphs, Matching and factors, Cuts and connectivity, k-connected graphs, Network flow problems, Graph coloring: vertex coloring and edge coloring, Line graphs, Hamiltonian cycles, Planar graphs, Perfect graphs.

Recommended References

1. Introduction to Graph Theory, Douglas B. West, Pearson Education, 2nd Edition, 2000.
2. Discrete Mathematics with Graph Theory, Ddgar G. Goodaire, Michael M. Parmenter, Pearson Education, 3rd Edition, 2005.
3. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Prentice-Hall of India Pvt.Ltd, 2004.
4. Extremal Combinatorics, S. Jukna, Springer-Verlag, Berlin, 2000.

CSE 5104: Computational Geometry

Credit Hour: 3.00

Prerequisite: None

Searching and Geometric Data Structures: Balanced binary search trees, Priority-search trees, Range searching, Interval trees, Segment trees, Algorithms and complexity of fundamental geometric objects: Polygon triangulation and art gallery theorem, Polygon partitioning, Convex-hulls in 2-dimension and 3-dimension, Dynamic convex-hulls; Geometric intersection: Line segment intersection and the plane-sweep algorithm, Intersection of polygons; Proximity: Voronoi diagrams, Delunay triangulations, closest and furthest pair; Visualization: Hidden surface removal and binary space partition (BSP) trees; Graph Drawings: Drawings of rooted trees (Layering, Radial drawings, HV-Drawings, Recursive winding), Drawings of planar graphs (Straight-line drawings, Orthogonal drawings, Visibility drawings); Survey of recent developments in computational geometry.

Recommended References

1. Computational Geometry and Computer Graphics in C++, Michael J. Laszlo, Prentice Hall, 1st Edition, 1995.
2. Planner Graph Drawing, Takao Nishizeki, Md. Saidur Rahman, World Scientific, 2004.
3. Graph Drawing: Algorithms for the Visualization of Graphs, Giuseppe Di Battista, Peter Eades, Roberto Tamassia, Ioannis G. Tolli, Prentice Hall, 1999.
4. Computational Geometry: Algorithms and Applications, Mark de Berg, 3rd Edition, Springer, 2008.
5. Computational Geometry: An Introduction, Franco P. Preparata, Michael Shamos, Springer, 1993.

CSE 5105: Bioinformatics Algorithms

Credit Hour: 3.00

Prerequisite: None

Introduction; *Molecular biology basics*: DNA, RNA, genes, and proteins; Restriction mapping algorithm; Motif in DNA sequences, motif finding algorithms; Genome rearrangements, sorting by reversals and breakpoints; DNA sequence alignments; Gene prediction; Space-efficient sequence alignments, sub-quadratic alignment; DNA sequencing, genome sequencing, protein sequencing, spectrum graphs; *Combinatorial pattern matching*: Exact pattern matching, heuristic similarity search algorithms, approximate string matching, BLAST, FASTA; *Clustering*: Microarrays, hierarchical clustering, K-means clustering, corrupted cliques problem, CAST clustering algorithm; Evolutionary trees.

Recommended References

1. Bioinformatics Computing, Bryan Bergeron, Prentice Hall, 1st Edition, 2002.
2. Introduction to Bioinformatics, T.K. Attwood, D.J. Parry-Smith, Pearson Education, 1st Edition, 1997.
3. An Introduction to Bioinformatics Algorithms, By Neil C. Jones, Pavel Pevzner, The MIT Press, 1st Edition, 2004.
4. Bioinformatics: A practical guide to the analysis of genes and proteins, A.D. Baxevanis and B.F.F. Ouellette (ed.), John Wiley & Sons, 3rd edition. 2004.
5. Biological sequence analysis, Probabilistic Models of Proteins and Nucleic Acids, Richard Durbin, Sean R. Eddy, Anders Krogh, and Graeme Mitchison, Cambridge University Press, 1998.

CSE 5106: Stringology

Credit Hour: 3.00

Prerequisite: None

Introduction to Stringology: Notations, Problems and Naive Solutions, Motivations, Applications, Basic string searching algorithms; Data structures for String Matching: Suffix Tree, Suffix Array, Aho-Corasick Automaton, Applications of these data structures; Approximate Pattern Matching: Edit distance, Dynamic programming, Similarity measures for DNA and protein sequences, q-gram methods, Bit-parallel methods, Algorithms for degenerate/indeterminate strings; Sequence Analysis: Longest Common subsequence (LCS) Problem, Advanced Algorithms for LCS, Variants of LCS and algorithms; Text Compression: Shannon-Fano and Huffman codes, Arithmetic coding, Lempel-Ziv family of compression techniques, Burrows-Wheeler Transformation.

Recommended References

1. Algorithms on Strings, Maxime Crochemore, Christophe Hancart, Thierry lecroq, Cambridge University Press, 2014.
2. Grammatical Inference: Learning Automata and Grammars, Colin de la Higuera, Cambridge University Press, 2010.
3. Computing Patterns in Strings, Bill Smyth Pearson/Addison-Wesley, 2003.
4. Flexible pattern matching in strings: Practical On-Line Search Algorithms for Texts and Biological Sequences, Gonzalo Navarro, Mathieu Ranot, Cambridge University Press, 2007.
5. Jewels of Stringology: Text Algorithms, Maxime Crochemore, Wojciech Rytter, World Scientic Publishing, 2002.

CSE 5107: Mathematical Programming

Credit Hour: 3.00

Prerequisite: None

Basic concept of Mathematical Programming, Concepts of linear and quadratic programming, Convexity, Convex sets and convex functions, Concept of integer programming, Some examples of integer programming problems, Linear programming techniques, Graphical solution of linear programming problems, Simplex method, Dual simplex method, Different integer programming techniques, Revised simplex method.

Recommended References

1. Mathematical Programming: Theory and Methods, S. M. Sinha, Elsevier, 2005.

2. Mathematical Programming, Kenneth D. Lawrence Emerald Group Publishing Limited, 2004.
3. Mathematical Programming, Steven Vajda Dover Publications, 2009.
4. Introduction to Linear Optimization, Dimitris Bertsimas, and John Tsitsiklis, Athena Scientific, 1997.

CSE 5108: Petri Net Theory and Modeling of Systems
Credit Hour: 3.00
Prerequisite: None
Introduction to Petri Nets, Elementary Net Systems, Place/Transition Nets, Definition and types of Petri nets, Terms and notations marking, Importance of net theory, Transition firings, Practical modeling examples, Introduction to workflow, workflow modeling using Petri Nets, Liveness and safeness, Behavioral properties, Deadlocks and siphons, Structural properties, Colored Petri Nets, Time Petri Nets, Timed Petri Nets, Stochastic Petri Nets.

Recommended References

1. Hardware Design and Petri Nets, Edited by Alex Yakovlev, Luis Gomes, Luciano Lavagno, Springer, 2000.
2. Modeling in Systems Biology: The Petri Net Approach, Ina Koch, Wolfgang Reisig, Falk Schreiber, Springer, 2011.
3. Petri Net Technology for Communication-Based Systems: Advances in Petri Nets, Hartmut Ehrig, Wolfgang Reisig, Grzegorz Rozenber, Herbert Weber, Springer, 2003.

CSE 5151: Cryptography
Credit Hour: 3.00
Prerequisite: None
Classical Cryptography; Data Encryption Standard, Advance Encryption Standard; Public-key cryptography: RSA cryptosystem, ElGamal cryptosystem; Signature Schemes: ElGamal signature schemes, Digital signature standard; Hash Functions: Collision-free Hash functions; Key Distribution and Key Agreement: Key pre-distribution, Diffie-Hellman key exchange; Identification Schemes: Schnorr identification scheme, Okamoto identification schemes; Algorithm to compute discrete logs; Chinese Remainder method, Polard's rho method; Attacks: Brute Force attack, Birthday attack; Cryptanalysis: Linear cryptanalysis, Differential cryptanalysis; Elliptic Curves; Quantum cryptography;

Recommended References

1. Foundations of Cryptography: Basic Tools, O. Goldreich, Cambridge University Press, 2001.
2. Cryptography and Network Security, William Stallings, Pearson Education, 6th Edition, 2013.
3. Applied Cryptography, Bruce Sehneier, John Willey & Sons, 2nd Edition, 1996.
4. Cryptography Engineering: Design Principles and Practical Applications, Niels Ferguson, Bruce Schneier, Tadayoshi Kohno, Wiley Publishing, Inc., 1st Edition, 2010.

Software Engineering and Information Systems

CSE 5201: Advanced Software Engineering
Credit Hour: 3.00
Prerequisite: None
Introduction to Software Engineering, Unified Modeling Language, Requirements Engineering, Design, Testing, Software Lifecycle, Refactoring, Extreme Programming, Requirements Engineering, Software Architecture, Service Oriented Architecture, Model Driven Architecture, Aspect Oriented Software Development, Software Processes.

Recommended References
1. Software Engineering: A Practitioner's Approach, Roger Pressman, Bruce Maxim, 8th Edition, 2014.
2. Fundamentals of Software Engineering, Carlo Ghezzi, Mehdi Jazayeri Dino Mandrioli, Prentice Hall, 2nd Edition, 2002.
3. Object Oriented Software Engineering using UML, Patterns, and Java, Bernd Bruegge, Allen H. Dutoit, Prentice Hall, 3rd Edition, 2009.

CSE 5202: Software Project Management
Credit Hour: 3.00
Prerequisite: None
Foundations of software project management; organization structure and staffing; motivation, authority and influence; conflict management; proposal preparation; a large engineering software system management; client management; managing software project teams; project planning and scheduling; risk management; configuration management; pricing estimation and cost control; quality assurance and accreditation; factors affecting software quality; software quality assurance plans; business context and legal issues for software projects; software measurement: testing, upgrading and maintenance; network systems; and international project management.

Recommended References
1. Software Project Management: A Concise Study, S. A. Kelkar, Prentice Hall of India, 2nd Edition, 2009.
2. Software Project Management: A Unified Framework, Walker Royce, Addison-Wesley Professional, 1st Edition, 1998.
3. Software Project Management in Practice, Pankaj Jalote, Pearson Education, 2002.

CSE 5203: Software Testing and Quality Assurance
Credit Hour: 3.00
Prerequisite: None
Definition and concept of software quality assurance (SQA); quality models; specification of quality requirements; product development & delivery issues; software development processes & maturity; software quality management process: total quality management, improvement cycle, SQA planning & management, organizing the SQA effort; software verification & validation; typical software development errors; Fagan inspections; software audit; software testing: testing objectives & testing fundamentals, testing theory, coverage criteria, equivalence class testing, value-based testing, decision table, syntax & state transition testing, statement & path testing, branch & condition testing, data flow testing, thread-based testing, integration & integration testing, system testing; testing in object-oriented systems; test tools & test automation; test management; problem reporting & corrective action.

Recommended References

1. Foundations of Software Testing, Aditya P. Mathur, Addison-Wesley Professional, 2nd Edition, 2014.
2. Software Testing: Principles and Practices, Srinivasan Desikan, Gopalaswamy Ramesh, Pearson Education, 1st Edition, 2006.
3. Handbook of Software Quality Assurance, G. Gordon Schulmeyer, Artech House Publishers, 4th Edition, 2007.

CSE 5204: Software Verification and Validation Tools

Credit Hour: 3.00

Prerequisite: None

Introduction to automated verification and validation of software, test execution systems, performance measurement tools, testing graphical user interfaces, coverage measurement and tools, web application testing, software security testing, introduction to model checking, verification tools (SMV, SPIN, DiVinE).

Recommended References

1. Software Verification and Validation: A Practitioner's Guide, Steven R. Rakitin Artech House: A Practitioner's Guide, Steven R. Rakitin, Artech House Publishers, 1997.
2. Software Verification and Validation: An Engineering and Scientific Approach, Marcus S. Fisher, Springer, 2007.
3. Verification and Validation of Modern Software-intensive Systems, G. Gordon Schulmeyer, Garth R. MacKenzie, Prentice Hall, 1st Edition, 2000.

CSE 5251: Advanced Database Systems

Credit Hour: 3.00

Prerequisite: None

Object Oriented Database; Data Model, Design, Languages; Object Relational Database: Complex data types, Querying with complex data types, Design; Distributed Database: Levels of distribution transparency, Translation of global queries to fragment queries, Optimization of access strategies, Management of distributed transactions, Concurrency control, Reliability, Administration; Parallel Database: Different types of parallelism, Design of parallel database; Multimedia Database SystemsBasic concepts, Design, Optimization of access strategies, Management of Multimedia Database Systems, Reliability; Database Wire-housing/Data mining: Basic Concepts and algorithms.

Recommended References

1. Fundamentals of Database Systems, Ramez Elmasri, Pearson Education, 5th Edition, 2006.
2. Object-Oriented Database Systems: Approaches and Architectures, C.S.R. Prabhu, Prentice Hall of India, 2nd Edition, 2005.
3. Database Systems The Complete Book, Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, Pearson Education, 2nd Edition, 2008.

CSE 5252: Information System Management

Credit Hour: 3.00

Prerequisite: None

Information systems management: importance of information systems (IS) management, IS management's leadership role, strategic uses of IT, IS planning; managing essential technologies: distributed systems, managing telecommunications, managing information resources, and managing operations; managing system development: technologies for developing systems and management issues in system development; systems for supporting knowledge work: supporting decision making, collaboration, and knowledge works; acquisition of hardware, software, networks, and services: request for proposal, acquisition methods (buy, rent, or lease), software acquisition, and analysis of alternatives; people and technology: the challenges ahead.

Recommended References

1. Information Systems Strategic Management: An Integrated Approach, Steve Clark, Routledge, 2nd Edition, 2006.
2. Outsourcing Management Information Systems, Edited by Marc J. Schniederjans, Ashlyn M. Schniederjans, Idea Group Inc (IGI), 2007.
3. Management Information Systems, S. Shajahan, New Age International, 2004.

Communications and Computer Networks

CSE 5301: Computer Communications and Networks
Credit Hour: 3.00
Prerequisite: None
Modifications of TCP; TCP over ATM; ATM internetworking; ATM service categories and quality of services; ATM switch architectures and their performance; Digital switching; Traffic analysis; Fiber optics networks optical packet switching; Metropolitan networks, Wide area networking, Gigabit Ethernet, ADSL.

HTTP, pHTTP and recent advances in internet protocols; Web server performance, proxy servers, load balancing in web servers; IP switching: Tag switching, Multi-protocol label switching; IP security; Queuing models for networks and protocols; Real time protocols: RTP, RTCP, RTSP; Voice over IP; Distributed object technology for networking; Networks agents; Active networks and protocol boosters, Multimedia Networking: Integrated Service, Differential Service, MPLS.

Recommended References
1. Data and Computer Communications, William Stallings, Prentice Hall, 10th Edition, 2013.
2. Computer Networks, Andrew S. Tanenbaum, Prentice Hall, 5th Edition, 2010.
3. Computer Networks and Internets, Douglas E Comer, Addison-Wesley, 6th Edition, 2014.

CSE 5302: Wireless and Mobile Communication Networks
Credit Hour: 3.00
Prerequisite: None
Characteristics of cellular communications; QOS in cellular communications; Wireless LAN; Wireless ATM and media access protocols for WATM; Wireless application protocols; Wireless personal communications; Mobile IP; Spread spectrum techniques: DSSS, FHSS, CDMA, GSM, CPDP; satellite communications; internetworking via satellites; Mobile satellite communications.

Recommended References
1. Mobile Communications, Jochen Schiller, Addison-Wesley, 2nd Edition, 2003.
2. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy, B.C. Manoj, Prentice Hall, 1st Edition, 2004.
3. Wireless Communication Systems: Advanced Techniques for Signal Reception, Xiaodong, Wang H., Vincent Poor, Prentice Hall, 1st Edition, 2003.

CSE 5303: Wireless Ad Hoc Networks
Credit Hour: 3.00
Prerequisite: None
Introduction: applications and motivations; broadcasting protocols: algorithmic aspect, optimization techniques, power-efficient broadcasting;, routing protocols: DSDV, AODV, DSR, position based routing protocols, load balancing techniques, multi-path routing; medium access control protocols: reservation-based MAC protocols, Bluetooth technology, IEEE 802.11 based MAC protocols; channel propagation models; topology control protocols; power aware protocol design; cross layer design principles; mobility awareness; fairness and security issues: attacks

and preventions; stimulating cooperation: self policing schemes, economic incentive based schemes; other state-of-the-art relevant topics.

Recommended References

1. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy, B.C. Manoj, Prentice Hall, 1st Edition, 2004.
2. Guide to Wireless Ad Hoc Networks, Edited by Sudip Misra, Isaac Woungang, Subhas Chandra Misra, Springer, 2009.
3. Ad Hoc Wireless Networking edited by Xiuzhen Cheng, Xiao H. Huang, Ding-Zhu Du, Springer, 2004.

CSE 5304: Wireless Sensor Networks

Credit Hour: 3.00

Prerequisite: None

Introduction: applications; Localization and tracking: tracking multiple objects; Medium Access Control: S-MAC, IEEE 802.15.4 and ZigBee; Geographic and energy-aware routing; Attribute-Based Routing: directed diffusion, rumor routing, geographic hash tables; Infrastructure establishment: topology control, clustering, time synchronization; Sensor tasking and control: task-driven sensing, information-based sensor tasking, joint routing and information aggregation; Sensor network databases: challenges, querying the physical environment, in-network aggregation, data indices and range queries, distributed hierarchical aggregation; Sensor network platforms and tools: sensor node hardware, sensor network programming challenges; Other state-of-the-art related topics.

Recommended References

1. Wireless Sensor Networks: An Information Processing Approach, By Feng Zhao, Leonidas J. Guiba, Morgan Kaufmann, 1st Edition, 2004.
2. Protocols and Architectures for Wireless Sensor Networks, By Holger Karl, Andreas Willig, Wiley Publishers, 2005.
3. Wireless Sensor Networks and Applications, By Yingshu Li, My T. Thai, Springer, 2008.

CSE 5305: Wireless Resource Management

Credit Hour: 3.00

Prerequisite: None

Resource management architecture: evolution and components of QoS and cross-layer architecture for bandwidth management; tri-band and smart antenna; handoff management; mobility prediction; resource management and connection admission control; bandwidth allocation and scheduling: real-time guaranteed and fair real-time scheduling; inter-domain radio resource management; high performance broadband architecture; wireless truthful computing; resource allocation of spatio-temporal division multiple access control; resource management schemes for connectivity: Piconet and scatternet; energy efficient MAC layer protocols for wireless ad-hoc networks; routing and resource discovery for wireless ad-hoc networks: QoS based routing, topology management, efficient resource discovery, hybrid routing protocols, and localization; energy efficient broadcasting and multicasting algorithms; power-conserving broadcasting and multicasting algorithms; scopes of increasing wireless resources, research and future developments.

Recommended References

1. Wireless Communications Resource Management, Byeong Gi Lee, Daeyoung Park, Hanbyul Seo, Wiley Publishers; 1st Edition, 2008.
2. Practical Radio Resource Management in Wireless Systems, By Sofoklis A. Kyriazakos, George T. Karetsos, Artech House INC, 2004.

3. Wireless Information Networks: Architecture, Resource Management, and Mobile Data, Jack M. Holtzman, Springer, 1996.

CSE 5306: Network Security

Credit Hour: 3.00

Prerequisite: None

Issues of Network security, treats to network security: wiretapping, impersonation, hacking, cracking, phishing, ID theft, authentication and authorization, firewalls, Virtual private networks, intrusion detection system; Secure network devices; security policies ; internet vulnerabilities; Web security, e-mail security, e-commerce security.

Recommended References

1. Cryptography and Network Security, William Stallings, Prentice Hall, 6th Edition, 2013.
2. Java 2 Network Security, Marco Pistola, Duane F. Reller, Deepak Gupta, Milind Nagnur, 2nd Edition, 1999.
3. Network Security Architectures, Sean Convery, Cisco Press, 1st Edition, 2004.

Intelligent Systems

CSE 5401: Advanced Artificial Intelligence
Credit Hour: 3.00
Prerequisite: None
Introduction, Advanced search techniques in AI, Knowledge based system design, Advanced plan generating systems, Bayesian network and probabilistic reasoning, Learning in neural belief networks, Practical natural language processing, Computer vision, Introduction to Robotics.

Recommended References
1. Advanced Artificial Intelligence, Zhongzhi Shi, World Scientific Publishing Company, 2011.
2. Artificial Intelligence: A Modern Approach, Stuart Jonathan Russell, Peter Norvig, Prentice Hall, 3rd Edition, 2009.
3. Artificial Intelligence: A Guide to Intelligent Systems, Michael Negnevitsky, Pearson Education Canada, 3rd Edition, 2011.

CSE 5402: Fuzzy Systems
Credit Hour: 3.00
Prerequisite: None
Basic Concepts of Fuzzy set theory; Fuzzy numbers; Aggregation operations of Fuzzy sets; The theory of approximate reasoning; Introduction to Fuzzy logic control; Fuzzy System Models and Developments; Fuzzy logic controllers; Defuzzification methods; Linguistic descriptions and their analytical forms; The flexible structure of fuzzy systems; Practical Aspects of Neural Networks.

Recommended References
1. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence/Book and Disk, Bart Kosko, Prentice Hall, Har/Dis Edition, 1991.
2. Introduction to Neuro-Fuzzy Systems, By Robert Fuller, Springer, 2000.
3. Fuzzy systems design principles: building Fuzzy IF-THEN rule bases, Riza C. Berkan, Sheldon L. Trubatch, Wiley-IEEE Press, 1st Edition, 1997.

CSE 5403: Machine Learning
Credit Hour: 3.00
Prerequisite: None
Definition of learning systems, Goals and applications of machine learning, Inductive Classification, Decision Tree Learning, Ensemble Learning, Experimental Evaluation of Learning Algorithms, Computational Learning Theory, Rule Learning: Propositional and First-Order, Artificial Neural Networks, Support Vector Machines, Bayesian Learning, Instance-Based Learning, Text Classification, Clustering and Unsupervised Learning, Language Learning

Recommended References
1. Genetic Algorithms in Search, Optimization & Machine Learning, David E. Gold Berg, Addison-Wesley Professional, 1st Edition, 1989.
2. Pattern Recognition and Machine Learning, Christopher M. Bishop, Springer, 2007.
3. Machine Learning: An Artificial Intelligence Approach, Volume 2, edited by Ryszard S. Michalski, Ryszard Stanisław Michalski, Jaime Guillermo Carbonell, Tom Michael Mitchel, Morgan Kaufmann, 1982.

CSE 5404: Advanced Pattern Recognition
Credit Hour: 3.00
Prerequisite: None
Introduction to formal languages, String languages for pattern description, Higher dimensional pattern grammars, Syntax analysis as a recognition procedure, Stochastic languages, Error-correcting parsing for string languages, Error-correcting tree automata, Cluster analysis for syntactic patterns, Grammatical inference for syntactic pattern recognition, Application shape analysis of wave forms and contours, Syntactic approach to texture analysis.

Recommended References
1. Pattern recognition: Statistical, Structural, and Neural Approaches, Robert J. Schalkoff, J. Wiley, 1992.
2. Pattern Recognition and Image Analysis, Earl Gose, Richard Johnsonbaugh, Steve Jost, Prentice Hall, Har/Dsk Edition, 1996.
3. Advanced Pattern Recognition Technologies with Applications to Biometrics, David Zhang, Fengxi Song, Yong Xu, Zhizhen Liang, Medical Information Science Reference, 1st Edition, 2008.

CSE 5405: Speech Recognition
Credit Hour: 3.00
Prerequisite: None
Introduction, Speech signal: production, perception and characterization, Signal processing and analysis; Pattern comparison techniques: distortion measures, spectral-distortion measures, time alignment and normalization; Recognition system design and implementation: source-coding, template training, performance analysis; Connected word models: two level DP, level building algorithm, one-pass algorithm; Continuous speech recognition: sub word units, statistical modeling, context-dependent units; Task oriented models.

Recommended References
1. Fundamental of Speech Recognition, Lawrence Rabiner, Biing- Hwang Juang, Prentice Hall, 1st Edition, 1993.
2. Advances in Speech Recognition: Mobile Environments, Call Centers and Clinics, Amy Neustein, Springer, 2010.
3. Computer Speech: Recognition, Compression, Synthesis, Manfred R. Schroeder, Springer, 1999.

CSE 5406: Machine Translation
Credit Hour: 3.00
Prerequisite: None
Theoretical problems: Definition, Context dependency, interpretation and translation; Engineering problems of machine translation: Maintainability, tunability, modularity, and efficiency; Linguistics-based MT: Compositionality and isomorphism, Declarative frameworks, Constraint-based formalisms; Knowledge-based MT: Translation and understanding, Design of interlinguas, The conceptual lexicon; Statistics-based MT: E-M algorithms, Alignment of bilingual corpora, Translation templates; Example-based MT: Similarity measures, Levels of comparison; Treatment of context dependency: Knowledge-based transfer, Sublanguage-based MT, Translation units.

Recommended References
1. Machine Translation: Its Scope and Limits, Yorick Wilks, Springer, 1st Edition, 2010.

2. Learning Machine Translation, edited by Cyril Goutte, Nicola Cancedda, Marc Dymetman, George Foster, The MIT Press, 2008.
3. Logic Programming, Knowledge Representation, and Nonmonotonic Reasoning, edited by Marcello Balduccini, Tran Cao Son, Springer, 2011.

CSE 5407: Knowledge Representation and Reasoning
Credit Hour: 3.00
Prerequisite: Basic course on Logic/AI
Knowledge representation, uses in computers; logic-based languages for KR; automated reasoning techniques and systems; applications of KR to ontologies and semantic web.

Recommended References
1. Knowledge Representation and Reasoning, Ronald J. Brachman, Hector J. Levesque, Morgan Kaufmann, 1st Edition, 2004.
2. Foundations of Knowledge Representation and Reasoning, edited by Gerhard Lakemeyer, Bernhard Nebel, Springer, 1994.
3. Knowledge Representation, Reasoning and Declarative Problem Solving, Chitta Baral, Cambridge University Press, 1st Edition, 2010.

CSE 5408: Advanced Data Mining
Credit Hour: 3.00
Prerequisite: None
Introduction; Data warehousing and OLAP technology for data mining; Data preprocessing; Data mining primitives, languages and systems; Descriptive data mining: characterization and comparison; Association analysis; Classification and prediction; Cluster analysis; Mining complex types of data; Applications and trends in data mining.

Recommended References
1. Principles of Data Mining, David Hand, Heikki Mannila, Padhraic Smyth, A Bradford Book, 2001.
2. Data Mining Introductory and Advanced Topics, Margaret H. Dunham, Pearson Education, 2006.
3. Data Mining: Next Generation Challenges and Future Directions, Hillol Kargupta, Anupam Joshi, Krishnamoorthy Sivakumar, Yelena Yesha, MIT Press Ltd, 2004.

CSE 5451: Evolutionary Algorithms
Credit Hour: 3.00
Prerequisite: None
Introduction to evolutionary algorithm; Selection: rank-based, roulette wheel, stochastic, local, truncation and tournament; Recombination: discrete, real valued and binary valued; Mutation: real valued and binary valued; Reinsertion: global and local; Population models: global-worker/farmer, local – diffusion, and regional – migration; Co-evolution: cooperative and competitive; Learnable evolution model; Fast evolutionary programming; Application of evolutionary algorithms to: system design, telecommunication, robotics and other industrial areas.

Recommended References
1. Evolutionary Algorithms in Engineering Applications, edited by Dipankar Dasgupta, Zbigniew Michalewicz, Springer, 1997.
2. Evolutionary Algorithms for Solving Multi-Objective Problems, Carlos Coello Coello, Gary B. Lamont, David A. van Veldhuizen, Springer, 2nd Edition, 2007.

3. Multi-Objective Optimization Using Evolutionary Algorithms, Kalyanmoy Deb, Wiley Publishers, 1st Edition, 2009.

CSE 5452: Neural Networks

Credit Hour: 3.00

Prerequisite: None

Fundamentals of Neural Networks; Back propagation and related training algorithms; Hebbian learning; Cohonen-Grossberg learning; The BAM and the Hopfield Memory; Simulated Annealing; Different types of Neural Networks: Counter propagation, Probabilistic, Radial Basis Function, Generalized Regression, etc; Adaptive Resonance Theory; Dynamic Systems and neural Control; The Boltzmann Machine; Self-organizing Maps; Spatiotemporal Pattern Classification, The Neocognition; Practical Aspects of Neural Networks.

Recommended References

1. Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence/Book and Disk, Bart Kosko, Prentice Hall, Har/Dis Edition, 1991.
2. Fundamentals of Artificial Neural Networks, Mohamad H. Hassoun, A Bradford Book, 2003.
3. Understanding Neural Networks and Fuzzy Logic, Stamatios V. Kartalopoulos, Wiley-IEEE Press, 1st Edition, 1995.

Multimedia Technology

CSE 5501: Multimedia Systems
Credit Hour: 3.00
Prerequisite: None
Overview to Multimedia Systems, Multimedia storage, Data compression techniques for audio and video, Synchronization, Multimedia networking and protocols, QOS principles, Video streams on ATM, Mobile multimedia communications, Operating system support for multimedia, Hypermedia system, Standards for multimedia, Multimedia database and Multimedia Applications.
Multimedia data: image, audio, and video; Image encoding: Transform coding, vector quantization, and Fractal encoding; Image encoding standards; Audio encoding: Liner predictive coding, filter bank design, psychoacoustic models, Code Excited Linear Prediction (CELP), Algebraic CELP, Regular Pulse Excitation, Multi Pulse Excitation, and Vector-sum Excited Linear Prediction ; Audio encoding standards; Video encoding: motion prediction (full search, ½ pel and ¼ pel precision), and Fine-granular scalable encoding (Bit-plane encoding); Video encoding standards; Video file formats; Video storage mediums; Audio-video Channel coding.

Recommended References
1. Multimedia Systems, Ralf Steinmetz, Klara Nahrstedt, Springer Berlin Heidelberg, 2010.
2. Introduction to Multimedia Systems, Urbashi Mitra, Academic Press, 2004.
3. Managing Multimedia: Project Management for Interactive Media, Elaine England and Andy Finney, Addison Wesley, 2nd Edition, 1998.
4. Multimedia Systems, John F. Koegel Buford, Addison-Wesley Professional, 1994.

CSE 5502: Computer Graphics and Animation
Credit Hour: 3.00
Prerequisite: None
Advanced Graphic Techniques: Graphics basics, Three dimensional drawings, Geometric forms and models, Hidden surfaces, Fractals; Advanced rendering Techniques: Shadow generation techniques, Texture and environment mapping techniques, Procedural texture mapping and modeling, Ray tracing, Radiosity methods, Global illumination models, Volume rendering techniques; Advanced Animation: Animation articulated structures, Soft object animation, Procedural animation.

Recommended References
1. Computer Graphics Using Open GL, F.S. Hill, Jr., Prentice Hall, 2nd Edition, 2000.
2. Computer Graphics Multimedia And Animation, Malay K.. Pakhira, PHI Learning, 2010.
3. Computer Graphics with OpenGL, Donald D. Hearn, M. Pauline Baker, Prentice Hall, 3rd Edition, 2003.

CSE 5503: Human Computer Interaction
Credit Hour: 3.00
Prerequisite: None
Psychopathology of everyday things: visibility, affordances, natural mapping; psychology of everyday actions: seven stages of action gulf of execution and evaluation; knowledge in the head and in the world; constraints; human errors; design challenges; user-centered design; Cognetics and locus of attention; meaning, modes, monotony, myths; quantification; unification; navigation.

Recommended References

1. Human-Computer Interaction, Alan Dix, Janet Finlay Gregory, D. Abovod, Russell Beale, Prentice Hall, 3rd Edition, 2003.
2. Human-Computer Interaction in the New Millennium, John M. Carroll, Addison-Wesley Professional, 1st Edition, 2001.
3. Interaction Design: Beyond Human - Computer Interaction, Yvonne Rogers, Helen Sharp, Jenny Preece, Wiley Publishers, 3rd Edition, 2011.

CSE 5504: Multimedia Communication

Credit Hour: 3.00

Prerequisite: None

Multimedia information representation, Multimedia networks, Multimedia services and applications, Network QoS and application QoS, Transform coding, Motion compensated predictive coding; Information representation: text, image, audio and video; Text and image compression: compression principles, text compression, image compression; Audio and Video compression: Audio compression, Video compression, Video compression principles; Multimedia compression standards: JPEG, H.26x, MPEG 1/2/4/7, AVC, Scalable Video Coding; Other coding formats for text, speech, image and video; Multimedia communication across networks: Layered video coding, Error relevant video coding techniques, Multimedia transport across IP networks and relevant products such as RSVP, RTP, RTCP, DVMRP, Multimedia in mobile networks, Multimedia broadcast networks, Content based retrieval in digital libraries; End-to-End QoS for video delivery, Wireless video, Error control in video streaming, Cross-layer video adaptation.

Recommended References

1. Multimedia Communications, Jerry D. Gibson, Academic Press, 2000.
2. Multimedia Communication Systems: Techniques, Standards, and Networks, K.R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Prentice Hall, 1st Edition, 2002.
3. Multimedia Communications- Applications, Networks, Protocols and Standards, Fred Halsall, Addison-Wesley, 1st Edition, 2000.

High-performance Computing

CSE 5601: Parallel Algorithms
Credit Hour: 3.00
Prerequisite: None
Introduction, Parallel processing, Parallel models, Performance of Parallel Algorithms, The work-time presentation framework, Basic techniques: Pointer jumping, Balanced trees, Divide and Conquer, Pipelining, Partitioning and symmetry breaking, List ranking, Euler-Tour technique, Tree contraction; Parallel searching, merging, sorting and selection, Connected components, Minimum spanning trees, Biconnected Components, Directed graphs, Plane sweeping, Visibility problems, Simulation between PRAM models, Lower hounds for EREW, CREW and CRCW PRAMs.

Recommended References
1. Introduction to Parallel Algorithms, C. Xavier, S. S. Iyengar, Wiley-Interscience, 1st Edition, 1998.
2. Parallel algorithms, Henri Casanova, Arnaud Legrand, Yves Robert, Chapman and Hall/CRC, 2008.
3. Efficient Parallel Algorithms, Alan Gibbons, Wojciech Rytter, Cambridge University Press, 1989.
4. Parallel Computer Architecture: A Hardware/Software Approach, David E. Culler, Jaswinder Pal Singh, and Anoop Gupta, Morgan Kaufmann Publishers, 1998.

CSE 5602: Distributed Computing Systems
Credit Hour: 3.00
Prerequisite: None
Distributed object systems, Retrieving and caching of distributed information, Distributed data replication and sharing, Performance issues, Algorithms for deadlock detection, Concurrency control and synchronization in distributed system, Models for distributed computation, Networking facilities and resource control and management methods in network and distributed operating systems, Collaborative applications, Wide area network computing, Web based commerce, Agent systems and Market based computing.
Large-scale distributed systems: properties and examples; search requirements in service discovery, peer-to-peer content sharing and distributed XML databases; unstructured techniques: intelligent flooding, hint-based routing, etc.; basic structured techniques: Chord, CAN, Tapestry, Kademlia, etc.; advanced structured techniques: pSearch, Squid, SkipNet, etc.; Signature search techniques using Bloom filters; Distributed Pattern Matching (DPM) problem and its applications; distributed crawling and indexing techniques.

Recommended References
1. Energy Efficient Distributed Computing Systems, Albert Y. Zomaya, Young Choon Lee, Wiley-IEEE Computer Society Press, 1st Edition, 2012.
2. Data Networks, Dimitri, and Robert Gallager, Upper Saddle River, NJ: Prentice Hall, 2nd Edition, 1991.
3. Programming Distributed Computing Systems: A Foundational Approach, Carlos A. Varela, The MIT Press, 2013.
4. Distributed Computing: Principles, Algorithms, and Systems, Ajay D. Kshemkalyani, Mukesh Singhal, Cambridge University Press, 2011.

CSE 5603: Distributed Databases
Credit Hour: 3.00
Prerequisite: Undergraduate database course
Principles in the design and implementation of distributed databases and distributed transaction processing systems. Topics include: distributed computing concepts, computing networks, distributed and multi-database system architectures and models, atomicity, synchronization and distributed concurrency control algorithms, data replication, recovery techniques, reliability in distributed databases.

Recommended References

1. Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez, Springer, 3rd Edition, 2011.
2. Distributed Database Management Systems: A Practical Approach, Saeed K. Rahimi, Frank S. Haug, John Wiley & Sons, 2010.
3. Distributed Databases, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw-Hill Education, 1984.
4. Digital Communications, Proakis, J. G., MA: McGraw-Hill, 4th Edition, 2001.

CSE 5604: Ubiquitous Computing
Credit Hour: 3.00
Prerequisite: None
Introduction to Ubiquitous Computing; Ubiquitous Computing Visionaries: mouse, Parc, MIT; Ethics; Privacy; Responsibility; Architecture: Autonomic Computing, Distributed Computing, Cloud Computing, Peer to Peer; Mobility: Mobile Computation and Agents, Smart Places, Wearable Computing; Service-Orientation; Sensors and Actuators; Ubiquitous environments; Ubiquitous theory: Location, Spatial Databases, Topological Reasoning, Metadata, Security and Privacy; Ambient Calculus; Relational Models; Specifications: UML, OMG, Ontologies; Context Awareness: GPS, location and tracking; Applications: Smart Homes, Smart Workplaces, Social Computing, Religious Computing, Health and Medical Computing, Science, Surveillance, Monitoring, Navigation.

Recommended References

1. Ubiquitous Computing Fundamentals, edited by John Krumm, Chapman and Hall/CRC, 1st Edition, 2009.
2. Ubiquitous Computing: Smart Devices, Environments and Interactions, Stefan Poslad, Wiley, 1st Edition, 2009.
3. Everyware: The Dawning Age of Ubiquitous Computing, Adam Greenfield, New Riders Publishing, 1st Edition, 2006
4. Communication Systems Engineering, Proakis, J. G., and M. Salehi, 3rd Edition, Englewood Cliffs, NJ: Prentice-Hall, 2004.

Hardware Systems

CSE 5701: Advanced Microprocessor
Credit Hour: 3.00
Prerequisite: None
Review of different microprocessors: 80486, 68040, V70, Gmicro processors; Comparing the architectures: RISC and CISC; Instruction set of machines: SPARC, INTEL, and MIPS; Study of microprocessors: Pentium II, Alpha 21064, MIS 6400, PA-RISC; Math coprocessors and microprocessors.

Recommended References

1. The Intel Microprocessors 8086/8088, 80/86 80188 80286, 80386, 80486, Pentium and Pentium Processor, Barry B, Brey, Prentice Hall, 8th Edition, 2008.
2. Microprocessor Architecture Program and Applications with the 8085, Ramesh S. Ganokar, Prentice Hall College Div, 4th Sub Edition, 1998.
3. Microprocessors and Interfacing, Douglas V Hall, Glencoe McGraw-Hill, 2nd Sub Edition, 1991.

CSE 5702: Advanced Logic Design
Credit Hour: 3.00
Prerequisite: None
Functional decomposition and Symmetric functions; Linear sequential machines; Reed-Muller expansions and their minimizations; EXOR based logic design; self-timed circuits; asynchronous design techniques; Digital logic circuit testing and testable design: testing of combinational and sequential logic circuits, design for testability and built-in self test; Digital logic simulation; Reverse logic synthesis.

Recommended References

1. Advanced Digital Logic Design: Using Verilog, State Machines, and Synthesis for FPGAs, Sunggu Lee, Thomson, 2006.
2. Switching Theory and Logic Design, C V S Rao, Pearson Education, 2006.
3. Advanced Digital Logic Design: Using Verilog, State Machines, and Synthesis for FPGAs Sunggu Lee, Cengage Learning, 1st Edition, 2005.
4. Digital Logic Design, Brian Holdsworth, Clive Woods, Newnes, 4th Edition, 2002.

CSE 5703: Computer Organization and Design
Credit Hour: 3.00
Prerequisite: None
Classification and addressing modes, Operands and Operations for Media and signal processing, instructions for control flow, Encoding an instruction set. Pipelined and Superscalar processors, Data hazards, Dynamic scheduling, Branch prediction, Hardware based speculation, Thread level parallelism. ILP with software approaches: Compiler Techniques, static branch prediction, static multiple issue, advanced compiler support for ILP. Basic Techniques of Integer Arithmetic, Floating-point Arithmetic, Speeding up Integer Addition, Speeding up Integer Multiplication and Division. Memory technology, RAIDs, organization for improving performance, Virtual memory and protection, Cache organization, Reducing cache miss rate and penalty. Busses, Performance measures, Designing I/O system, Reliability, Dependability and Availability. Symmetric shared memory architectures, Cache coherence protocols, Distributed shared memory architectures, Synchronization, Models for memory consistency, Multithreading. Interconnection Networks-

Practical issues, Network on chip, Designing cluster. Advanced RISC, CISC and Embedded processors architectures.

Recommended References

1. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson, John L. Hennessy, Morgan Kaufmann, 5th Edition, 2013.
2. Computer Organization & Architecture Designing for Performance, Prentice Hall, 9th Edition, 2012.
3. Computer Organization and Design, P. Pal Chaudhuri, PHI Learning Private Limited, 3rd Edition, 2013.

CSE 5704: Advanced Computer Architecture

Credit Hour: 3.00

Prerequisite: None

Measuring performance and cost: performance measurement, Benchmarks, costs of building computers; Instruction sets: classifying instruction sets; improving CPU performance: pipelining, dynamic instruction scheduling, branch prediction, instruction-level parallelism, VLIW processor; vector processors: architecture and design, performance; memory hierarchy: evaluation, cache design and optimization, virtual memory design, memory protection, memory coherency; storage systems: reliability and availability, I/O system design; Multiprocessors: parallel architecture classification, centralized vs distributed shared memory, interconnection topologies, synchronization.

Recommended References

1. Advanced Computer Architecture, Kai Hwang, Tata Mcgraw-Hill Education, 2nd Edition, 2011.
2. Computer Architecture and Parallel Processing, Kai Hwang, Mcgraw-Hill College, 1st Edition, 1984.
3. Advanced Computer Architecture A Systems Design Approach, Richard Y. Kain, Prentice Hall, 1st Edition, 1995.
4. Advanced Computer Architectures A Design Space Approach, Dezso Sima, Terence Fountain, Peter Kacsuk, Addison-Wesley, 1st Edition, 1997.

CSE 5705: Embedded Systems

Credit Hour: 3.00

Prerequisite: None

Embedded computing, characteristics of embedded computing applications; embedded system design; constraint-driven design; development environment: execution environment, memory organization, system space, code space, data space, I/O space, start-up, interrupt response cycle, function calls, runtime environment; computing platform: CPU bus, memory devices, I/O devices, component interfacing; distributed embedded system design: inter-process communication; networks for embedded system; Design techniques: design methodologies and tools; system integration, structural and behavioral description.

Recommended References

1. Making Embedded Systems: Design Patterns for Great Software, Elecia White, O'Reilly Media, 1st Edition, 2011.
2. Embedded Systems: Architecture, Programming And Design, Kamal Raj, Tata McGraw-Hill Education, 2nd Edition, 2008.
3. Computer Organization & Architecture Designing for Performance, Prentice Hall, 9th Edition, 2012.

Special Topic

CSE 5999: Special Topic on X
Credit Hour: 3.00
Prerequisite: None

Remarks: ‘X’ will be a complete course name offered by the course teacher.

CSE 6000: Master Thesis I (Research Proposal)
Credit Hour: 6.00
Prerequisite: CSE 5000: Scientific Research Methodology and CSE 5001: Seminar

Remark: Successful completion of this course leads a student to undertake the course CSE 6001: Master Thesis II (Research) in the next term (with continue). Upon successful completion of CSE 6001: Master Thesis II (Research), grade will be awarded for this course.

CSE 6001: Master Thesis II (Research)
Credit Hour: 12.00
Prerequisite: CSE 6000: Master Thesis I (Research Proposal)

CSE 6002: Master Project
Credit Hour: 6.00
Prerequisite: CSE 5000: Scientific Research Methodology and CSE 5001: Seminar